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THE

LADY'S PRACTICAL ARITHMETICIAN,

OR

CONVERSATIONAL ARITHMETIC,

IN WHICH ALL THE RULES ARE EXPLAINED IN EASY AND
FAMILIAR LANGUAGE:

TO WHICH IS ADDED

A Short Hiſtory of the Coinage;

WITH

ABLES OF THE WEIGHTS AND MEASURES OF THE ANCIENTS.

ADAPTED TO THE USE OF

LADIES' SCHOOLS AND PRIVATE FAMILIES.

BY MRS. HENRY AYRES,

AUTHORESS OF

"ADDRESSES TO THE YOUNG."

SECOND EDITION.

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BIBLIOTHECA · BODLEIANA ·

LONDON:
Printed by A. SPOTTISWOODE,
New-Street-Square.

PREFACE.

In submitting the following pages to the public, the writer does not make any pretension to new discoveries in the science of Arithmetic, nor does she wish in any way to depreciate the value of those works already written on the subject, in order to claim superiority for her own. The design of the present work is to simplify and render agreeable and pleasing to children a study which is frequently looked upon by them as tedious and incomprehensible, and therefore only regarded with feelings of dread and dislike.

The course adopted by the author of explaining the science by means of familiar dialogues, may be objected to by some: there are, however, many advantages gained by this mode of explanation, which a formal system of language would never obtain: and the author has endeavoured to explain not only the *practical* part of Arithmetic, but the *principles* also, by presenting them to the youthful mind through the medium of the common occurrences of life.

The examples are chiefly selected from history, science, and art, that the student may see how every rule has its proper adaptation, and how much one branch of education may be the means of facilitating another. The examples given for exercise under some of the rules may be omitted till the pupil is more advanced, and after having thoroughly mastered those less difficult, they will be found of great benefit.

The tables of the weights and measures of the ancients are intended to assist the young in their historical studies; and though not usually inserted in works of this kind, the author considers them an essential part of an English education, serving to elucidate many parts of history, which writers frequently leave unexplained to the reader. The changes made into English value are calculated from the most approved modern authors on the subject; and when any uncertainty exists about the value, it is stated. The account of our own coinage will, it is hoped, prove useful and interesting to the student.

The answers to the questions have not been given, but a key has been prepared for the use of teachers, which will be found of great benefit both in schools and private families.

The author would here remark that this branch of a lady's education is considered of too little importance, and neglected, by many, for accomplishments which are rarely brought into exercise in after-life; not that she would underrate the utility of cultivating talents that render woman a cheerful and polished member of society, and an ornament to the circle in which she moves; far otherwise; but it is the mistaken habit of permitting accomplishments to take the place of useful knowledge, that she condemns; an error generally discovered too late to be remedied: for how much soever a refined taste and an accomplished mind may enhance the pleasures of life, if useful knowledge be sacrificed to them entirely, it is like raising the superstructure of a building without a foundation; and for want of which the comforts of a family circle too frequently sink into confusion and irretrievable misfortune.

Much care has been bestowed to render this edition as correct as possible; but in a work containing so much labour, a few errors will occasionally be found. The author, however, is desirous that the merit of the work should rest entirely on the candid judgment and good feeling of those friends and the public who have hitherto bestowed on her a large share of liberal encouragement.

St. John's Wood, Regent's Park,
London, 1846.

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CONVERSATIONS
ON
ARITHMETIC.

INTRODUCTORY CONVERSATION,

BETWEEN A MOTHER AND HER DAUGHTER LAVINIA.

LAVINIA.

Mamma, do you know Henry frequently laughs at me about the very little knowledge that girls have of Arithmetic, and says, that they are scarcely able to calculate the amount of a greengrocer's or a milkman's bill?

MAMMA.

Well, my dear Lavinia, I must say that much ignorance of numbers prevails among your own sex; but this, I think, arises from the small importance attached to it by parents in the education of their children; so much time is spent upon what are termed "accomplishments," in the present day, which probably may never be required in after life, that very little is thought of the actual knowledge necessary for every-day occurrences: and the instructors of the young too frequently consider it not at all an *essential* part of a lady's education. The superiority which Henry has over you in this respect arises from the great time which he has spent in figures at school.

LAVINIA.

But do you think that we are incapable of understanding, Mamma?

MAMMA.

By no means. For although boys are more capable of pursuing difficult studies, you would find if much more time were spent by you in acquiring a knowledge of numbers, that you would perform all that is required in your station, with as much ease as Henry does the various calculations in his Papa's office.

LAVINIA.

Well, I have great confidence in what you say, Mamma; and I will be diligent in striving to gain a *thorough* knowledge of as much as my situation requires.

MAMMA.

Well, my dear girl, a *resolution* to acquire knowledge, is the first step towards gaining it; and I hope your determination will be followed by industry and perseverance, and you will soon find your efforts crowned with success. If you will go to Papa's library, and bring me the volume of the Edinburgh Cyclopædia, which treats of Arithmetic, you will find there something to encourage you.

LAVINIA.

Here it is, Mamma; shall I read what Dr. Brewster says?

MAMMA.

Proceed, my dear Lavinia.

LAVINIA.

" It has often been alleged, but certainly without justice, that the levity of the female character is unfit for the severer exercises of the understanding. It may be affirmed, with more truth, that the mental superiority of the other sex is not so much the effect of any original endowments of the mind, as of a more extended education, assisted by other accidental causes. Italy, in modern times, has given birth to many illustrious women, who have distinguished themselves in the most difficult departments of science; and the school of Alexandria, in a much earlier period, furnished an example of the same kind, in Hypatia, the daughter of Theon. This celebrated young lady, who was equally remarkable for her beauty and accomplishments, modestly declined the proposals of many suitors, and resolved to sacrifice the charms of love to the higher and more exquisite delights of Philosophy. She wrote a commentary on Apollonius, and another on Diophantus," (two of the most distinguished mathematicians of the Alexandrian school) "besides some astronomical tables."

MAMMA.

This is a very encouraging narrative, my dear; and we have a very striking instance in our own country, in the writings of Mrs. Mary Somerville on Astronomy, that a lady is capable of accomplishing the most difficult studies.

LAVINIA.

But I fear I shall want some assistance in order to remove many difficulties, or industry and perseverance will be useless.

MAMMA.

That must be the case, my dear, and I will take care that it shall be obtained; but as I must pay a visit to Mrs. Fairland, in the Crescent, before dinner, we must resume the subject at a future time, when, I think, I can introduce you to a lady who will give you all the assistance you require.

LAVINIA.

That is very kind, Mamma; and I look forward to the fulfilment of your promise to-morrow.

[*Mamma introduces Lavinia to her friend Constantia.*]

MAMMA.

You see, my dear Lavinia, I have not forgotten my promise. It is with much pleasure that I introduce you to my friend Constantia, who has kindly offered to render you all the assistance in her power to obtain a knowledge of numbers; therefore, my child, pray remember what I have said, and pay her every attention.

LAVINIA.

Dear Mamma, my resolution is as strong as ever to persevere in a study so useful; and I look forward with much pleasure to the kind assistance of your friend.

CONSTANTIA.

My dear Lavinia, the tenderness and solicitude of your Mamma cannot be more amply repaid than by your willingness to improve the talents you possess: and the arrangements which I have made with her to assist you, as far as I am able, in acquiring some knowledge of Arithmetic, I shall with pleasure fulfil; therefore I shall anticipate meeting you to-morrow, when we will begin the subject in earnest.

LAVINIA.

I thank you, kindly, Constantia; all my energy shall be used to profit by your instruction, and I hope that a lasting friendship will be formed between us from this simple beginning. In the morning, at nine, we shall meet. Adieu!

CONVERSATION II.

ON THE HISTORY OF ARITHMETIC.

CONSTANTIA.

Good morning, my dear Lavinia: I am glad to see you in such good spirits this morning, on entering upon your new study.

LAVINIA.

Well, I have anticipated it with pleasure, and I wish to study it with the same degree of cheerfulness.

CONSTANTIA.

What I shall first introduce to your notice is something of the History of Arithmetic

LAVINIA.

That I should very much like, for I am told there is something very ancient about it.

CONSTANTIA.

Arithmetic takes its name from the Greek word *Arithmêtike,* which signifies the art of numbering.

There is always a difficulty in tracing the origin of an art or science, through the distant ages of obscurity. This is particularly the case with

Arithmetic, for we have no means of knowing by whom it was first invented, or when first introduced among mankind. Probably its progress was facilitated through the multiplied transactions of men, in their commercial intercourse with each other; and it is probable that its improvements were gradual, according to their various wants. It is a decided proof of civilisation, when the inhabitants of a country are become skilful in arithmetical calculation; and we find, on the other hand, that barbarous nations have little, if any, knowledge of numbers; it is also a proof of a great interchange of national wealth: for without wealth, or treasures of some kind, numbers can be of no use; and so ignorant are many of the American tribes, that they have no idea whatever of calculation: and they can only reckon as far as two or three; beyond that number they point to the hair of their heads, to indicate that it is too great a number for them to reckon.

It is very probable that Arithmetic was an Indian invention, for the Chaldeans, the Egyptians, and Indians distinguished themselves, at a very early period, by their astronomical calculations, many of them indicating a very advanced state of computation; but, although many have claimed the honour of this noble invention, its origin will be for ever hid in obscurity; and we can only trace it through its various improvements, in after ages, amongst the civilised nations of the world. Josephus says that Abraham was the inventor of

Arithmetic. Strabo says it was invented by the Phœnicians; and others that the first system of it was written in the Phœnician language by Agenor, the son of Phœnix; but it is quite clear that this is not correct; though it is known that the Phœnicians were a great commercial people, and therefore, probably, made numerous improvements from their neighbours the Egyptians.

The Greeks were exceedingly proud of being considered the inventors of numbers; but it is evident they copied their method of Notation from the Hebrews by using the letters of their alphabet to represent figures.

Thales, an ancient Greek mathematician, who lived about six hundred and forty years before Christ, went into India and Egypt for the express purpose of acquiring a store of knowledge, and measured the height of the Pyramids by means of their shadows; which is the first instance on record of Arithmetic having been applied to Geometry.

The word calculate is supposed to be derived from the Latin word *calculus,* a small stone or pebble, by which the ancients made their calculations; and even to the present day, in many of the Eastern countries, the inhabitants use stringed beads, or small stones, for this purpose.

The figures or symbols we now use were received from the Arabs, who ascribe the invention to the Hindoos — there are various statements as to when it was first introduced into Europe. But it is said that the Arabs carried a knowledge of it into Spain, and from thence it was brought into France by Pope Sylvester II., in the middle of the tenth century; but there is great difficulty in tracing its progress through the early periods of its introduction into this country. The Arabic characters are found in an Italian manuscript as early as 1317, and there is a date upon a window in a part of the old Roman wall at Colchester, as early as 1090, and also one on each side of the church porch at Stratford St. Mary, Suffolk, of the fifteenth century.

These characters form what is termed Decimal Notation, from the Latin word *Decem*, ten, which is generally, and very probably, supposed to have arisen from the easy method of numbering the ten fingers; and hence the term digit, is sometimes used to express these symbols, from the Latin word *digitus*, a finger.

One of the earliest writers on Arithmetic was Nicomachus, who lived about 200 years before Christ.

Diophantus is said to be the inventor of Algebra, a system of Arithmetic in which the letters of the alphabet are made use of to represent numbers and quantities. You must not, however, look at the present state of perfection which Arithmetic has obtained, as being anything like that of ancient times; for although the Greeks were acquainted with the method of extracting the square and cube roots (a part too difficult for you now to understand) we must look to the inventions of modern times for the great improvements made in this branch of our sciences; for up to the sixteenth century, accounts were kept in Roman figures, and we may also find them used in old registers of parish churches, till about that period. This is only a brief outline of the history of Arithmetic, for, upon many points of it, information is so scanty, and the truth so difficult to obtain, that it would be, perhaps, both tedious and useless to pursue it further, as I am anxious to bring you to a knowledge of its practice.

LAVINIA.

Well, I feel greatly indebted to you for your kindness in giving me so interesting an account of its history; and while many great and learned men have given it so much attention, I am sure that it must be a valuable study to pursue.

CONSTANTIA.

It is indeed valuable, my dear Lavinia, and in almost every transaction in life, it is more or less required. We will now proceed to the different rules in regular order.

CONVERSATION III.

ON NOTATION AND NUMERATION.

CONSTANTIA.

The first rules we have to notice in Arithmetic are Notation and Numeration; Notation is the art of *writing* numbers, and Numeration is the art of *reading* them.

LAVINIA.

Are these rules considered a *necessary* part of Arithmetic?

CONSTANTIA.

Decidedly so. All the other rules would be useless without them, and you would be quite ignorant of the *value* of numbers; but it is no uncommon thing for children to become acquainted with the working of most of the rules in arithmetic, and yet know nothing of the value of the figures when they are asked to numerate them, from the great neglect which many teachers have shown to this rule at the commencement of teaching numbers.

LAVINIA.

Perhaps you will give me some explanation by example, that I may understand your meaning more clearly.

CONSTANTIA.

Certainly; for a thorough knowledge of Arithmetic depends upon your understanding the *simple* rules first. I will use my utmost care to instruct you in them correctly.

The following figures, which are the symbols used in arithmetic, I shall place in regular order, beginning at number one, and set down the rest towards the right hand thus: —

NUMERATION TABLE, No. 1.

					1000	100	10	1
1	2	3	4	5	6	7	8	9
Hundreds of Millions...	Tens of Millions.........	Millions......................	Hundreds of Thousands	Tens of Thousands......	Thousands....................	Hundreds.....................	Tens..............................	Units............................

In the following table I have reversed the order of the figures, beginning at number nine, placing the rest towards the right hand: —

TABLE, No. 2.

9	8	7	6	5	4	3	2	1
Hundreds of Millions...	Tens of Millions.........	Millions......................	Hundreds of Thousands	Tens of Thousands......	Thousands....................	Hundreds.....................	Tens..............................	Units............................

You may here see the value of figures depends, not upon the numbers themselves, but upon the *places* which they occupy.

In the *first* table, the figure 9 stands for nine *units;* in the *second* table, it stands for *nine hundred millions:* and the value of every figure is increased in a ten-fold proportion towards the left hand, thus:—the figure 9 in the first table stands for nine units; and the figure 8 increased in a ten-fold degree, stands for eighty; seven stands for seven hundred; 6 for six thousand, and so on with all the rest; to make this appear clear to you, I have placed the ratio in which they increase in value over a few of the numbers of the *first* table.

LAVINIA.

It appears, then, that the value of a figure can only be known by its *situation?*

CONSTANTIA.

Exactly so: for you will see by the *second* table, a very great difference exists, according to this circumstance, between the value of any two figures; and though the number *one* is generally understood to signify *one* of any thing, its value in numbers depends, like all the other figures, upon the situation it occupies, as you may see by the following form of placing it:—

1	One
10	Ten
100	Hundred
1000	Thousand
10000	Ten thousand
100000	Hundred thousand
1000000	Million

I thank you; I see now very clearly, that the value of every figure must depend upon its place; and it increases in value, as it is distant from the *unit's* figure. Are there no higher figures used in Arithmetic than millions?

CONSTANTIA.

Yes; some authors use the terms billions, trillions, quadrillions, quintillions, sextillions, septillions, octillions, and nonillions; but this method of Notation is used by the French; when they arrive at hundreds of millions they say billions — but we use thousands of millions, ten thousands of millions, hundreds of thousands of millions, billions, — consequently billions in English are a thousand times greater than in French, as the following tables will show: —

French.	English.
Units	Units
Tens	Tens
Hundreds	Hundreds
Thousands	Thousands
Tens of thousands	Tens of thousands
Hundreds of thousands	Hundreds of thousands
Millions	*Millions*
Tens of millions	Tens of millions
Hundreds of millions	Hundreds of millions
Billions	Thousands of millions
Tens of billions	Ten thousands of millions
Hundreds of billions	Hundreds of thousands of millions
Trillions	*Billions*
Tens of trillions	Tens of billions
Hundreds of trillions	Hundreds of billions
Quadrillions	Thousands of billions.

LAVINIA.

But you have said nothing of those 0's that you have made use of in the above examples, respecting the figure 1.

CONSTANTIA.

They are called *ciphers*, or *noughts*, and signify nothing, except some figure is placed *before* them, then they increase in value in a tenfold degree, towards the left hand, the same as the rest. The figures we now use were formerly, all of them, called ciphers, and this is why the art of numbers is frequently called *ciphering*. The word itself is derived from an Arabic word, signifying *vacant*.

LAVINIA.

But did the ancients use the same kind of Notation that we do?

CONSTANTIA.

No: the Greeks had several methods of notation.

LAVINIA.

But what kind of numbering is that which we have in our Prayer Books and Bibles? It is not like the figures we use in Arithmetic.

CONSTANTIA.

No: this method of notation was used by the ancient Romans, who, like the Greeks and Hebrews, made use of the letters of the alphabet. The following is a table of the ancient Roman numbers as high as nine thousand: —

TABLE OF ROMAN NOTATION.

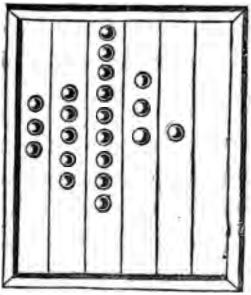
I	1	X	10	C	100	CIↃ or M	1000
II	2	XX	20	CC	200	MM or $\overline{\text{II}}$	2000
III	3	XXX	30	CCC	300	MMM or $\overline{\text{III}}$	3000
IIII or IV	4	XXXX or XL	40	CCCC or CD	400	MMMM or $\overline{\text{IIII}}$ or $\overline{\text{IV}}$	4000
V	5	L	50	D or IↃ	500	IↃↃ or $\overline{\text{V}}$	5000
VI	6	LX	60	DC or IↃC	600	IↃↃM or $\overline{\text{VI}}$	6000
VII	7	LXX	70	DCC or IↃCC	700	IↃↃMM or $\overline{\text{VII}}$	7000
VIII	8	LXXX	80	DCCC or IↃCCC	800	IↃↃMMM or $\overline{\text{VIII}}$	8000
VIIII or IX	9	LXXXX or XC	90	DCCCC or IↃCCCC or CM	900	IↃↃMMMM or $\overline{\text{IX}}$	9000

As often as any character is repeated its value is repeated.

When Ↄ is annexed to IↃ it makes the value tenfold greater, thus: IↃ represents five hundred, but IↃↃ represents five thousand; also the prefixing of C and annexing Ↄ to CIↃ increases its value tenfold, thus: CIↃ stands for one thousand, but CCIↃↃ for ten thousand.

The bar or horizontal line, drawn over a letter, increases it one thousand times, thus: X stands for ten, but X̄ stands for ten thousand, and so on.

The ancients also made use of a square table or tray for the purpose of calculation, called the Abacus — divided into partitions, each partition having a different value for the stones placed in it. The following figure is supposed to be the probable form of it.



The vacant space on the right hand is intended for *units*, the next for *tens*, and the next place for *hundreds* and so on. Upon this principle the stones in the Abacus would represent 359,310.

Mathematicians also used the Abacus or tray covered with *sand* for the purpose of drawing diagrams.

Instead of the above form, wires may be fixed in the place of the lines with beads to slide up and down.

The Chinese make use of the Abacus, which they call *shwànpan*, and use it with an extraordinary facility. The Russians also make use of this instrument for calculation.

The word Abacus is supposed to be derived from the Greek word *Abax* which signifies a square table or tray made of any material.*

I think I have explained all that is necessary on this head, and I will leave you a few examples for exercise in my absence, first giving you a rule for expressing *words* by *figures*, and then *figures* by *words*.

RULE I.—*To express Words by Figures.*

Place ciphers from the right hand towards the left, till the first cipher shows the highest place in the *given* number, then place beneath it the figure which points out the number you wish to express; then observe where the next significant figure stands towards the right hand, and place it beneath that cipher as you did the other, and so on to the end of the given number.

---

* See Penny Cyclopædia, and Greek and Roman Antiquities.

Examples.

1. Write in figures, seven millions, four thousand.

By referring to the *second* numeration table you will find that the number 7 expresses millions, and as that is the highest number you want to express, place, as under, seven ciphers.

Millions	Hundreds of Thousands	Tens of Thousands	Thousands	Hundreds	Tens	Units
0	0	0	0	0	0	0
7	0	0	4	0	0	0

Then write the figure 7 beneath *millions:* continue to write down ciphers to the right hand, till you come to thousands, and place down the 4, and the example is completed.

2. Write in figures, seventy-five millions, forty-five thousands, one hundred and seventy-five; this example will stand thus: —

00,000,000
75,045,175

3. Express in figures, eighteen millions, six hundred and sixty-four thousand, seven hundred and sixty-one, which was the population of Great Britain in 1841.

4. *Express in figures,* thirty-two millions three

hundred and forty-two thousand four hundred, the number of acres of land in Great Britain.

5. The cost of building St. Paul's Cathedral, amounted to seven hundred and thirty-six thousand seven hundred and fifty-two pounds, and was raised by a tax upon coals; write the amount in figures.

6. New London Bridge was opened August 1st, 1831, and cost six hundred and fifty thousand pounds; express the value in figures.

RULE II. — *To express Figures by Words.*

Find the value of the given number by your Numeration Table, and write it down in words at length.

Examples.

7. Write in words the following numbers: 2,558,351.

By your Numeration Table you will see that the highest number is two millions, which write down first, and the rest towards the right hand thus: — Two millions, five hundred and fifty-eight thousand, three hundred and fifty-one.

The following examples are applicable to the rule above, and are for your practice till we meet again.

Write the following numbers in words at length: —

8. 1066. Norman Conquest.
9. 1693. Bank of England established.
10. 1344. Gold first coined in England.

11. 1752. China made at Chelsea.

12. 1769. Duke of Wellington, Buonaparte, and Mehemet Ali born.

13. 1815. Battle of Waterloo.

14. 1838. Queen Victoria crowned.

15. 1841. Tower of London burnt, and Prince of Wales born.

16. 1842. A treaty of peace made with China; which opened a trade for English merchants.

CONVERSATION IV.

ON SIMPLE ADDITION.

CONSTANTIA.

Well, Lavinia, I suppose you have finished the first rule in Arithmetic; and the next we must take in hand is Addition, which consists of two forms, *simple* and *compound;* but as Addition, Subtraction, and Multiplication have each a compound form, I shall talk of the simple form of each rule first, and the *compound* afterwards; for those who are acquiring fresh knowledge, do not form such correct ideas of what they are learning, when too many things are talked of at one time.

LAVINIA.

I shall be most happy to attend to any of your arrangements in my pursuit after knowledge; but will you be so kind as to point out to me the *use* of this rule?

CONSTANTIA.

Certainly; your question is too important to be overlooked; and it would be well if all young ladies, who are engaged in the different branches of education, would ask the question, "What is the *use* of that which I am now learning?"

I shall endeavour to point out to you, as far as *I am able, the* use of every rule as we proceed.

LAVINIA.

Thank you, Constantia, that is very kind of you.

CONSTANTIA.

The rule of Simple Addition teaches how to add any number of figures together into one sum, and is performed by placing one number beneath another; taking care to begin at the unit's place with every line of figures and set down *units* under *units*, *tens* under *tens*, and *hundreds* under *hundreds*, to the highest number mentioned; draw a line beneath them, add up the *units* row first, and see how many *tens* it contains in it, and what number of units remains; put down the *units* under the line you have added, and carry *one* for every ten to the next line; proceed in this manner with the rest, setting down the units which are over the number of tens, under the line you have been adding, and carrying the tens to the next row of figures, except when you add the *last* row, when you must place the *tens* which are over to the left of the line you have added.

Examples.

1. Add together the following sums:

```
 632
 216
 342
 121
 375
————
1686
————
  11 Carrying Figures.
```

In adding up the above sum you must say 5 and 1 are six, and 2 are eight, and 6 are fourteen, and 2 are sixteen: in the number sixteen there is only one *ten* and six *units* over; place the 6 beneath the figures you have been adding, and carry *one* to the next row for the *ten*, and so on with the rest.

In the last line you find that the amounts is sixteen, for which you place 6 beneath the row you have been adding, and the 1 on the left for the ten, and the sum is finished.

Work out the following examples, and tell me what will be the value of each amount separately; this will exercise you in the rule Numeration.

(2) 6321 814 6127 1498 6210 1854	(3) 5126 4186 3518 2140 6193 2857	(4) 1876540 615178 21765 416483 27615 6841
(5) 49136 35124 78960 21534 30716 26148	(6) 57168 17321 70695 29063 94134 21645	(7) 61352 40768 52134 43760 12407 31864

LAVINIA.

I have finished all the examples you gave me to do, and I want to know what you wish me to do next.

CONSTANTIA.

Well, I will say a little about the *use* of this rule, now you understand something of it.

The use of this rule is to find the *whole* amount of any given number of *simple* sums, however numerous they may be; for instance, if you travel from London to Birmingham by Railway, and thence to Liverpool, thence to York, and back again to London, if you know the distance between each of these places, it will enable you to know how many miles you have travelled, by adding them together.

It also enables yon to find out when a person will arrive at a certain age, first knowing the year in which he or she was born; suppose you were born in the year 1828, you will be 20 years of age in 1848; because it is quite clear if you add 20 years to 1828, it will make 1848; and so of any person's age if you know the year of his birth.

LAVINIA.

O, that is very useful; and now I can tell my brother Henry when he will be an old man, if he should live; this will show him that I have made *some progress* in Arithmetic.

Examples for Exercise.

8. Add into one sum 6496380, 519682 53100427, 3215643, and 41603024.

9. From the creation of the world to the birth

of Christ were 4004, how many years is it since to the present year, 1846?

10. How long is it since the city of Rome was founded, which took place 753 years before Christ?

11. The land of England consists of 10,900,000 acres of arable land, 14,200,000 acres of meadow land, and uncultivated 7,932,400 acres; what is the whole number of acres?

12. A person travelling, went 45 miles the first day; 69 the second; 58 the third; and 63 the fourth; after staying at the end of the fourth day's journey a short time amongst his friends, he returned home by the same route, and travelled the same number of miles per day; what was the number of miles he had travelled?

13. In a steam vessel of 300 horse power, having a capacity to carry passengers 3000 miles, and the proportions of weight as follow: — machinery 300 tons; weight of coals 600 tons; weight of passengers 100 tons; and weight of goods 200 tons; what would the whole of the tonnage amount to?

14. Sir Isaac Newton, the great Astronomer, was born in 1642, and lived to the age of 84; in what year did he die?

15. If a person commences rearing bees, and begins with 2 hives, what number would he have in ten years, allowing each hive to produce *one* every year during that period?

CONVERSATION V.

ON SIMPLE SUBTRACTION.

CONSTANTIA.

Well, Lavinia, I must give you praise for being very industrious, and I think we may now proceed to the next rule, which is called *Simple* Subtraction.

This rule teaches you how to find the difference between any two *simple* numbers, and to take a *less* number from a *greater;* and it is performed by placing the *greater* number down first, beginning at the unit's figure; then, beneath that number, place the one which is *less*, taking care to let *units* stand under *units*, *tens* under *tens*, &c.

Begin at the unit's place, and take the lower figure from the one above it, and place the difference underneath; but if the lower figure be *greater* than the one above, borrow *ten*, as it is called, which add to the top figure, and then subtract the lower from that number, place the difference beneath, as before, remembering always to carry *one* to the next lower figure whenever you have added *ten* to the upper one. When both numbers are alike, nothing remains.

For *proof* of the work add the *difference* and the *less* number together, and the sum will be equal to the *greater* number, if not, the work is wrong. The following example will make the rule clear to you: —

1. From 6437 take 3154, which place thus:

6437 greater number
3154 less
3283 difference
6437 Proof.

Here I first take 4 from 7 and there remains 3, which I place beneath; but in the next place I cannot take the 5 from 3, therefore I add 10 to the 3 and it makes 13. I then take 5 from 13 and the difference is 8, and because I added 10 to the last figure I carry 1 to the next, which you must always attend to.

After having subtracted the less number from the greater, I add the *difference* and the *less* number together for the proof, which is shown to be correct, by its being like the greater number, and which may be shown more simply thus: —

If I buy 12 yards of lace, and let you have 4 yards of it, I have 8 yards left for myself; and the difference between what I bought and what remains is 4 yards; but if you return me the 4 yards, I have my original quantity, thus: —

Yards.
12 bought
4 lent
8 difference
12 Proof.

LAVINIA.

Thank you, I see this very clearly; but if you borrow *ten* to add to a figure, how is it that you carry only *one?*

CONSTANTIA.

If you remember, I told you when we conversed about Numeration, that the value of each figure increases tenfold towards the left hand; therefore, if you borrow *ten* in the units place, it is equal only to *one* in the *tens* place; for instance, in the first example, you borrow ten in the *tens* place, and as you have to carry to the place of *hundreds* you would make it *ten* hundred instead of *one* hundred, if you carried 10 to the next figure.

LAVINIA.

I understand: this *one* in the next place, is equal to *ten* in the number where you borrowed it.

CONSTANTIA.

Certainly it is; for if I lend you 12 pence, it does not follow that you need give me *twelve pence* to pay me, because you can do it with *one shilling.*

Examples.

	(2)	(3)	(4)
From	417623	869325	617398
Take	162986	493716	175469
Remainder			
Proof			

5. From 31006216 take 91835. 30914381.
6. From 7463150 take 362519. 7100631.

7. From 4106903 take 521863. 3585040.
8. From 8612154 take 172. 8611982.
9. From 6441088 take 94360. 6346728.
10. From 324627 take 10090. 314537.

The use of this rule is very evident; for if your mamma gives the servant one sovereign or 20 shillings, and orders her to lay out 5 shillings in tea, 3 in butter, and 2 in sugar, which make 10 shillings, from the 20, there are 10 shillings remaining, which is the sum the servant should return to your mamma.

LAVINIA.

I shall ask mamma, the next time she sends to market, to let me tell her what money the servant should bring back.

CONSTANTIA.

I think you had better be a little more skilful in figures first; for if she has to lay out odd sums of money, such as halfpence and farthings, you would not so easily reckon them, and the servant might have a laugh at you.

Questions for Exercise.

11. A farmer having an estate, consisting of 790 acres of land, upon which he had saved sufficient money to retire from business, resolved, for the benefit of his five children, to give them each a portion, while he was living, according to their ages, beginning at the eldest, named Albert, whose

portion was 98 acres; to Edward 95 acres; to Henry 83; and to Alice and Caroline, each 100 acres. What quantity remained for them to inherit at the death of their father, when the remainder was to be divided equally?

12. William the Conqueror began to reign in the year 1066; how many years elapsed between that period and the battle of Waterloo, which was fought and gained by the English over Napoleon Bonaparte, in 1815?

13. A lady, dying, bequeathed to four poor widows, a dwelling-house and 25*l.* per year each, out of an annuity of 127*l.* per annum; and the rest to be spent in teaching ten poor girls to read and write. What sum was left for the girls after paying the widows?

14. Three boys at marbles, A., B., and C., won together 105: if the number that B. and C. won be added together they will make 82, and of this number B. won 47, what did each boy win at play?

15. The highest of the mountains in Himalaya measures 26,862 feet above the level of the sea; what is the difference between the height of it and the top of the Duke of York's monument, at the bottom of Regent Street, the column of which is about 123½ feet above the surface of the ground, and the statue measures about 13½ feet high?

LAVINIA.

As you wish me to ask an explanation of what

I do not understand, pray what is the meaning of the words *per annum?*

CONSTANTIA.

They are two Latin words, and signify *by the year;* and in speaking of yearly payments, it is common to say so much *per annum.*

CONVERSATION VI.

ON SIMPLE MULTIPLICATION.

CONSTANTIA.

OUR next rule for consideration, my dear girl, is called Multiplication, from its signifying to make greater. It shows you how to perform, at one operation, what would require several in Addition; it is, therefore, only a short method of performing that rule.

The number to be multiplied is called the *multiplicand*, the number you multiply by the *multiplier*, and the number which is produced by Multiplication is called the *product;* sometimes both multiplier and multiplicand are called *factors*, and you must remember, we do not call the result of the work the *sum*, as in Addition.

Before you proceed to any examples in this rule, you must learn *perfectly* the following table, which is called the Multiplication Table, from its application to this rule. This is an ingenious invention of Pythagoras, in which all the figures are placed in the *first* row as high as 12; in the *second* every one is *doubled*, and in the rest the digit in the first row is added to every number, till you reach the number 12 in the right hand direction; but, in order to perform this rule with ease to yourself, do not fail to be quite *perfect* in this table. I have put it into a more convenient form below, for you to commit to memory, in No. 2.

MULTIPLICATION TABLE. (No. 1.)

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

MULTIPLICATION TABLE. (No. 2.)

Twice			Three Times			Four Times			Five Times		
1	are	2	1	are	3	1	are	3	1	are	5
2	...	4	2	...	6	2	...	8	2	...	10
3	...	6	3	...	9	3	...	12	3	...	15
4	...	8	4	...	12	4	...	16	4	...	20
5	...	10	5	...	15	5	...	20	5	...	25
6	...	12	6	...	18	6	...	24	6	...	30
7	...	14	7	...	21	7	...	28	7	...	35
8	...	16	8	...	24	8	...	32	8	...	40
9	...	18	9	...	27	9	...	36	9	...	45
10	...	20	10	...	30	10	...	40	10	...	50
11	...	22	11	...	33	11	...	44	11	...	55
12	...	24	12	...	36	12	...	48	12	...	60

Six Times			Seven Times			Eight Times			Nine Times		
1	are	6	1	are	7	1	are	8	1	are	9
2	...	12	2	...	14	2	...	16	2	...	18
3	...	18	3	...	21	3	...	24	3	...	27
4	...	24	4	...	28	4	...	32	4	...	36
5	...	30	5	...	35	5	...	40	5	...	45
6	...	36	6	...	42	6	...	48	6	...	54
7	...	42	7	...	49	7	...	56	7	...	63
8	...	48	8	...	56	8	...	64	8	...	72
9	...	54	9	...	63	9	...	72	9	...	81
10	...	60	10	...	70	10	...	80	10	...	90
11	...	66	11	...	77	11	...	88	11	...	99
12	...	72	12	...	84	12	...	96	12	...	108

Ten Times			Eleven Times			Twelve Times			Twenty Times		
1	are	10	1	are	11	1	are	12	1	are	20
2	...	20	2	...	22	2	...	24	2	...	40
3	...	30	3	...	33	3	...	36	3	...	60
4	...	40	4	...	44	4	...	48	4	...	80
5	...	50	5	...	55	5	...	60	5	...	100
6	...	60	6	...	66	6	...	72	6	...	120
7	...	70	7	...	77	7	...	84	7	...	140
8	...	80	8	...	88	8	...	96	8	...	160
9	...	90	9	...	99	9	...	108	9	...	180
10	...	100	10	...	110	10	...	120	10	...	200
11	...	110	11	...	121	11	...	132	11	...	220
12	...	120	12	...	132	12	...	144	12	...	240

LAVINIA.

I have now perfectly learned the table you gave me, which I can see must be very useful to know.

CONSTANTIA.

So much so, my dear, that you will, henceforth, require the use of it all through Arithmetic.

I will now show you that this rule is only a short way of performing Addition.

Suppose you must find the total of 6 times 3 — by Addition it would stand thus: —

$$\begin{array}{r} 3 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3 \\ \hline 18 \\ \hline \end{array}$$

Now, look in your table above for 6 times 3, and you will find it is 18. In the present rule, therefore, it will stand thus: —

Multiplicand	3
Multiplier	6
Product	18

The same result will be produced by making 6 the *multiplicand*, and 3 the *multiplier*, thus: —

Multiplicand	6
Multiplier	3
Product	18

RULE I. To multiply by a *single* figure, or any number as high as 12 in your table. Write the multiplier under the unit's place of the multiplicand, and multiply each figure by it; when the product is *less* than 10, put it down: when it is *more* than 10, carry *one* for every *ten* to the product of the next figure.

Example.

(1)

Multiply	814627453
by	2
Product	1629254906
Carrying figures	1 1 1

Here you see the first product is 6, which, being less than *ten*, is placed beneath the figure you have multiplied; the next product is 10, for which you write down the nought, and carry *one* to the next figure, and say twice 4 are 8, and 1 make 9, and so on with the rest. A little practice will make it familiar to you; and for your better understanding it I have put down the carrying figures, and have also given you another example in which the numbers are higher.

Example.

(2)

Multiply	64876549
by	5
Product	324382745
Carrying figures	2433224

LAVINIA.

Yes; I see that carrying to the next figure is similar to what you showed me in Addition, and in the *last* product *both* the figures are set down.

CONSTANTIA.

Precisely the same, my dear.

RULE II. We now come to another form of the rule where *ciphers* are on the right hand of the *multiplier ;* in this case you proceed as before, and place the number of ciphers in both factors on the *right hand* of the *product.*

(3) Multiply 6487654900
by 500
Product 3243827450000

RULE III. When there are *two* figures in the multiplier that may be found in your Multiplication Table — as 25 is the product of 5 times 5: multiply the multiplicand by *one* of these figures first, and that product by the other. The number 25 is called a *composite* number, because you can produce it by multiplying two together: but 26 is not so, because you cannot find two whole numbers that will produce it when multiplied; therefor 26 is an *odd* number.

Example.

(4) Multiply 32718965
by 5
1st Product 163594825
by 5
2nd Product 817974125

This sum may be worked thus: —

(5) Multiply 32718965
by 25
163594825
65437930
Product 817974125

Here, you must observe, in multiplying by the 2, I place the *first* figure of the product under it, and proceed to the left, as before, and then add the two lines together: it gives the product the same as in the 4th Example.

The latter example may be applied to any number containing *more* than two figures, thus: —

Example.

$$
\begin{array}{lrr}
(6) & \text{Multiply} & 6154287 \\
 & \text{by} & 4365 \\
\hline
 & & 30771435 \\
 & & 36925722 \\
 & & 18462861 \\
 & & 24617148 \\
\hline
 & \text{Product} & 26863462755 \\
\hline
\end{array}
$$

Rule IV. The last rule which I shall lay down for your multiplying simple numbers is, where there are ciphers intermixed with figures in the multiplier. Omit the ciphers, and proceed to multiply by the next *significant* figure, placing the product immediately beneath it, thus: —

Example.

$$
\begin{array}{lrr}
(7) & \text{Multiply} & 34209635 \\
 & \text{by} & 36004 \\
\hline
 & & 136838540 \\
 & & 205257810 \\
 & & 102628905 \\
\hline
 & \text{Product} & 1231683698540 \\
\hline
\end{array}
$$

When there are ciphers in the multiplier and multiplicand, omit the ciphers in multiplying, and place them to the right hand of the product, as many as there are in the multiplier *and* the multiplicand, thus: —

Example.

(8) Multiply 641325000
by 165000

3206625
3847950
641325

Product 105818625000000

Proof. — The simplest method of proving your work, is to *reverse* the order of it, as was shown to you in 6 times 3, which is the same as 3 times 6, thus: —

Example.

(9) Multiply 432
by 235

2160
1296
864

Product 101520

The same Example reversed.

(10) Multiply 235
by 432

470
705
940

Product 101520 as before.

There are other methods, my dear Lavinia, of proving Multiplication; but as you cannot understand them without a knowledge of Division, they are not of importance to notice here.

LAVINIA.

Well, I do think, after the care you have taken to explain this rule, that I shall very soon understand it in all its forms.

CONSTANTIA.

The following examples are for practice, till we meet again, and will give you exercise under every rule: —

Examples.

11. Multiply 4216321 by 2.
12. Multiply 3142705 by 3.
13. Multiply 2461064 by 4.
14. Multiply 1634258 by 5.
15. Multiply 7493012 by 6.
16. Multiply 87100541 by 7.
17. Multiply 24863102 by 8.
18. Multiply 38642796 by 9.
19. Multiply 21973505 by 10.
20. Multiply 94630466 by 11.
21. Multiply 100539642 by 12.
22. Multiply 3615429 by 24.
23. Multiply 2172608 by 36.
24. Multiply 6239705 by 45.
25. Multiply 540632 by 63.
26. Multiply 734569 by 84.
27. Multiply 4658270 by 132.
28. Multiply 5376148 by 144.
29. Multiply 763421702 by 315.
30. Multiply 2406993164 by 458.
31. Multiply 3765216043 by 647.

32. Multiply 421642857 by 4365.
33. Multiply 792153046 by 5893.
34. Multiply 537469214 by 6758.
35. Multiply 416627837 by 406.
36. Multiply 93004643 by 34002.
37. Multiply 51296409 by 590406.
38. Multiply 84635086 by 600471.
39. Multiply 63741868 by 402057.
40. Multiply 5631000 by 4700.
41. Multiply 34856500 by 2050000.
42. Multiply 60304000 by 608500.

In working the above examples take care to observe under which rule they fall, and you will then find them very simple.

Questions for Exercise.

43. If a steam-carriage travels at the rate of 25 miles an hour, how many miles will it travel in a week, at the same rate, allowing 12 hours a day, and 6 days to the week?

44. There are about 120 tons of steel used annually in making pens, and each ton is sufficient for making 1,900,000; how many are annually made from the 120 tons?

45. The earth travels at the rate of 68,000 miles an hour; what number of miles will it pass through in one year of 365 days, at the same velocity?

46. By the Marquis of Tweeddale's patent brick machine, 24 bricks may be made in a minute; how many will be made in a day of 14 hours?

47. How many times does the minute hand of a clock move round the dial plate in a year of 365 days?

48. The Temple of Diana at Ephesus was burned down by Herostratus the day on which Alexander the Great was born, 356 years before Christ, and it contained 117 pillars, each 70 feet high; what length would they extend, if placed in a straight line?

49. The consumption of pins is estimated at 16 millions a day; what then is the average consumption in a year, or 365 days? and how many will a boy point in that time, if he can do 16 thousand pins in an hour?

50. The pendulum* of a clock that will beat one second of time at every oscillation, is 39 inches and one-fifth part of an inch long; how many oscillations will such a pendulum make in 12 hours?

---

* The *pendulum* is that part of a clock which swings backwards and forwards inside, and regulates the hands upon the dial-plate; its movements are called *oscillations*.

CONVERSATION VII.

ON SIMPLE DIVISION.

Our present subject, Lavinia, is called Division, and is the last of the *simple* rules in Arithmetic, and having completed your knowledge of this, you will have the foundation of the whole system of figures; for every rule that follows is only a different form of application of these five rules.

Division is a short method of performing Subtraction, and shows how often one number is contained in another, or may be taken from it.

The number to be divided is called the *dividend;* the number you divide by, the *divisor;* and the number of times the divisor is contained in the dividend, the *quotient:* when the dividend does not contain the divisor an equal number of times, the figures that are over are called the *remainder,* which is always *less* than the *divisor.*

Rule I.—When the divisor does not exceed 12, place the *dividend* down on your slate first, and draw a line under it; on the left hand place the *divisor.* See how often the divisor is contained in the *first* figure, or the *first* and *second* figures, if the first figure is *less* than the divisor; place down underneath the number of times it is contained in the first or first and second figures of the dividend, and for each unit that remains, carry 10 to the next figure: proceed in this manner till you have divided all the figures in the dividend.

Proof.—Multiply the quotient by the divisor, and add in the remainder, and the sum will equal the dividend.

Example.

(1.) Divide 3632175 by 2.

Dividend
Divisor 2) 3632175
Quotient 1816087 1 Remainder
2
Proof 3632175

In this example I find 2 is contained in 3 only *once*, and 1 remains, which is one *unit;* for which I carry 10 to the 6, which makes 16; the 16 contains the divisor 8 times without any remainder; therefore I do not carry any to the next figure, but see how often 2 is contained in 3, and so on with each figure till I have divided all in the dividend. The 1 which is over at the last is the remainder.

Another Example.

(2.) Divide 53940164 by 6.

Dividend
Divisor 6) 53940164
Quotient 8990027—2 Remainder.

In this example, you see, the divisor is not contained in the *first* figure; therefore, I take *two* figures, and see how often 6 is contained in 53, and then proceed as before.

LAVINIA.

You have explained this to me very clearly; but you have not shown to me how Division is a short method of performing Subtraction.

CONSTANTIA.

Well, my dear, I will endeavour to do so. Now suppose you have 12 apples, and you wish to divide them into parcels of 4 each, by Division it would stand thus: —

$$\begin{array}{r} 4)\ \underline{12} \\ \underline{3} \end{array}$$

By Subtraction, thus: —

12 Number at first
4 Subtract
8 First remainder
4 Subtract
4 Second remainder
4 Subtract
0

You may plainly see, that having taken away the first 4, there are 8 remaining; take away a *second* parcel, and 4 remain; take away a *third* parcel, and nothing remains; which shows that 4 is contained in 12 *three* times. It shows, also, how many each person would have if you would give four persons each an equal number — namely, 3; for by giving them 3 each, the 4 persons would possess 4 times 3, which make the 12.

LAVINIA.

Really this is very clearly shown. I think, Constantia, I cannot fail to understand it.

CONSTANTIA.

This rule, as well as Multiplication, has many forms to claim your attention; but application and care will carry you easily through them.

I shall now explain to you another form, under RULE II., where the divisor is a *composite* number, similar to those mentioned in Rule III. of Multiplication.

Divide the dividend by *one* of the component parts, and the quotient of that division by the other; should there be a remainder on each quotient, multiply the *first divisor* by the *last remainder*, and to that product add the *first* remainder for the true one.

If there should be a remainder to the *first* quotient *only*, it is the true one; if a remainder to the *last* only, multiply it by the *first divisor*, and the product will be the true remainder.

These are remarks, my dear girl, that you must continually bear in mind, if you would understand what you are doing.

The following examples will illustrate the different forms of this rule: —

Example.

(3.) Divide 37486246 by 24

$$\begin{array}{rll} & 6) & \underline{37486246} \\ 24 & 4) & \underline{6247707-4} \\ \text{Quotient} & & \underline{1561926-3} \end{array}\left.\begin{array}{l} \\ \\ \\ \end{array}\right\} 22\ \text{Remainder}$$

(4.) Divide 26541545 by 27.

$$\begin{array}{rll} & 9) & \underline{26541545} \\ 27 & 3) & \underline{2949060-5}\ \text{Remainder} \\ \text{Quotient} & & \underline{983020} \end{array}$$

(5.) Divide 65317028 by 42.

$$\begin{array}{rll} & 7) & \underline{65317028} \\ 42 & 6) & \underline{9331004} \\ & & \underline{1555167-2=14}\ \text{Remainder.} \end{array}$$

These three examples show you every form of the rule above, and, before I proceed to converse upon the next rule, I will give you some examples for practice.

Examples.

6. Divide 6412734651 by 2.
7. Divide 3621842796 by 3.
8. Divide 4276903961 by 4.
9. Divide 2635417214 by 5.
10. Divide 5007342173 by 6.
11. Divide 3765273618 by 7.
12. Divide 4113946821 by 8.
13. Divide 928654708 by 9.
14. Divide 304976165 by 10.
15. Divide 261783424 by 11.

16. Divide 442806538 by 12.
17. Divide 716418342 by 27.
18. Divide 913726137 by 36.
19. Divide 420614098 by 72.
20. Divide 639851723 by 108.
21. Divide 720694386 by 120.
22. Divide 416385519 by 132.
23. Divide 573962876 by 144.

The next part of this rule is where the divisor consists of several figures, and is called Long Division. This is the most difficult part of the rule for a learner to understand; however, you must not stop on account of difficulties, for they will all vanish by degrees as you advance.

RULE III. When the divisor consists of several figures.

Find how many times the divisor is contained in as many figures of the dividend as you require, and place the number on the right hand, for the quotient; multiply the *divisor* by this number, and place the product under those figures of the *dividend* before mentioned; *subtract* this product from the figures of the dividend under which it stands; then bring down the next figure of the dividend, or more if required, which place on the right hand of the remainder: divide this number as before, and proceed in the same manner, till you have brought down all the figures of the dividend.

If, after bringing down *one* figure to any remainder, and the number is still *less* than the *divisor,* bring down the next figure of the dividend, or more, if required: but take care to place a *cipher* in the quotient, for every figure so brought down *more* than one.

Proof. For proving Division, the simplest method is to multiply the *quotient* by the *divisor,* and add in the *remainder,* if any; if the work be correct, this sum will be equal to the *dividend.*

Second method. Subtract the *remainder* from the *dividend,* and divide what is left by the quotient, and the *last quotient* shall be equal to the first *divisor,* when the work is correct.

Example.

24. Divide 476342 by 23.

```
            Dividend
Divisor 23) 476342  ( 20710 Quotient
            46          23
            ----     -----
            ·163      62130
             161     41420
             ---        12 Remainder
              ··24   ------
                23   476342 Proof by Multiplication
              ----   ------
               ·12 Remainder
              ----
               476342 Dividend
                   12 Remainder
               ------
Quotient 20710) 476330 (23 Proof by second method
                41420
               ------
                62130
               ·62130
               ------
                .....
               ------
```

In the above example, I find how many times 23 is contained in 47, which I find to be twice; I place the 2 in the quotient, multiply the *divisor* by it, and place the product under the dividend; subtract that product from it, and the remainder is 1; I bring down the next figure from the *dividend,* and place it to the right hand; but the remainder is then *less* than the divisor, therefore, I place a *cipher* in the quotient, and bring down the next figure, which is 3, and I find it will go 7 times. — I proceed thus, till all the figures of the dividend are brought down, and the quotient is found to be 20710, which multiply by 23 the divisor, and add 12 the remainder, and this sum is the same as the dividend; therefore, the work is correct. The next proof is by the *second* method.

LAVINIA.

This rule appears very easy to *you,* but how am I to know the number of times, when there are many figures in the divisor?

CONSTANTIA.

I confess this is a difficulty to a beginner, and can only be overcome by practice; but, in order to make your work more easy, it is a good plan at first, to place your *divisor* on the side of your slate, and multiply it by the number of times in the quotient, at every figure you place there, thus: —

Example.

25. Divide 69314752 by 61438

```
61438 ) 69314752 (     1128  Quotient
        61438          61438
        --------      -------
        ·78767          9024             61438
         61438          3384                 1
        --------       4512             -------
         173295       1128               61438
         122876      6768               -------
        --------        12688            61438
        ·504192      ---------               1
          491504     69314752  Proof    -------
        --------     ---------           61438
Remainder ·12688                        -------
        --------                         61438
                                             2
                                        -------
                                        122876
                                        -------
                                         61438
                                             8
                                        -------
                                        491504
                                        -------
```

Here you see every product as you place a figure in the quotient; and, although you will not require it when you become familiar with the rule, it will assist you at the commencement of it; for there is a difficulty to beginners in multiplying the divisor by the quotient, without placing them down together, when the divisor contains many figures.

Note. In this rule you have these four things to bear in mind — first, *seek how many times* — secondly, *multiply* — thirdly, *subtract* — and lastly, *bring down* from the dividend.

After *subtracting*, if the remainder be *greater* than the *divisor*, it will go more times in the *quotient;* and, whenever there is an *equal* number of *ciphers* in the divisor and dividend, you may cut them off entirely, thus: —

Example.

26. Divide 52789000 by 468000.

```
468,000) 52789,000 (112
         468
         ---
          598
          468
          ----
          1309
           936
          ----
           373 Remainder
```

Examples.

27. Divide 37642187 by 374.
28. Divide 21374269 by 1672.
29. Divide 461093750 by 2610.
30. Divide 3785169428 by 53764.
31. Divide 83064916100 by 31800.
32. Divide 521386473 by 210685.
33. Divide 32476784 by 30409.
34. Divide 10904218 by 684716.
35. Divide 7319586341876 by 8754.
36. Divide 840763517409 by 612355
37. Divide 51492846168 by 817000.
38. Divide 900173619856 by 918975.

It sometimes happens that you require to divide by $\frac{1}{2}$ (one half); $\frac{1}{3}$ (one third); $\frac{1}{4}$ (one fourth), &c. with the whole number; whenever this is the case you must multiply both the divisor and dividend by the *under* figure of the fraction, and add in the *upper* for the divisor, thus: —

Example.

39. Divide 5276384 by $5\frac{1}{2}$

```
           5½     5276384
           2            2
          ─────────────────
          11 ) 10552768
               ────────
Quotient       ··959342—6=3
                      11
               ────────
               10552768  Proof
               ────────
```

This sum may likewise be proved by multiplying the quotient by 5, and dividing by 2 for the half, and take in the 3 as the remainder, thus:—

```
           5½     5276384
           2            2
          ───   ─────────
          11 ) 10552768
               ────────
            ½     959342—6=3 Remainder
                        5
               ────────
                  4796713
                   479671
               ────────
                  5276384 Proof
               ────────
```

This applies equally to any larger divisor; and whatever figure is the *upper* part of the fraction, always add it for the *divisor*, when you multiply the whole number by the *under* figure; but the remainder will consist of quarters, halves, or thirds, &c., according to the nature of the *under* figures in the fractional part; as, in the example above, you have, after dividing by 11, a remainder of 6, but having multiplied your divisor by 2, they are 6 halves, which are equal to three whole numbers, therefore 3 is the *true* remainder. The following examples will serve to exercise you in this part of the rule:—

Examples.

40. Divide 37865402 by $3\frac{1}{2}$.
41. Divide 26432198 by $4\frac{1}{3}$.
42. Divide 31298608 by $2\frac{2}{5}$.
43. Divide 29635473 by $6\frac{3}{8}$.
44. Divide 71402165 by $293\frac{1}{4}$
45. Divide 42614298 by $71\frac{1}{15}$.

Questions for Exercise.

46. What number, multiplied by 459, will produce 7186104?

47. Four boys having been at play at marbles, agreed to share *equally* whatever number they won; at the conclusion of the game they found they had won 108, what was each boy's share?

48. Intelligence from London to Portsmouth by Telegraph is transmitted in about 15 minutes of time; supposing the distance of the telegraphic route to be 500 miles, at what rate per minute are despatches conveyed by this method?

49. What is the difference between the ninety-fifth part of 68150, and the one hundred and twenty-third part of 829635?

50. The great silk mill which was erected by Sir Thomas Lombe, in 1734, from a drawing which he obtained in Italy at the hazard of his life, stands on a small island of the river Derwent, near the town of Derby; it has 26,586 wheels; and 97,746 movements, which are all worked by one water-wheel, that turns round 3 times in a

minute. This machine will twist 318,496,320 yards of silk thread in 24 hours: how many yards is that in a minute?

51. Subtract 842 out of 261893526 as often as you can, and see what the last remainder exceeds or falls short of 450.

CONVERSATION VIII.

ON THE CHARACTERS AND TERMS MADE USE OF IN ARITHMETIC.

CONSTANTIA.

WELL, I think, Lavinia, as you have now gone through all the simple rules of Arithmetic, that we may say a little about the *characters* and *terms* made use of by those who study it.

LAVINIA.

I do not understand what you mean by *characters* in Arithmetic.

CONSTANTIA.

Well, I will tell you what I mean: there are certain *characters* or *signs* made use of in Arithmetic, to abbreviate or shorten the work; and there is a sign to each of the four rules you have just finished: they are as follow: —

+ signifies *plus* or + *more,* and is the sign of *Addition.* When two numbers are to be added, you place it between them: thus, 4 + 6 means that 6 is to be added to 4.

— denotes *minus* or *less,* and is the sign of *Subtraction;* when it is placed between two numbers, the *latter* is to be taken from the *former;* thus, $6 - 3$ shows that 3 is to be subtracted from 6.

$\times$ denotes *into* or *by,* and is the sign of *Multiplication;* when it is placed between two numbers, it shows that they are to be multiplied together; thus 5×4 denotes that 5 is to be multiplied by 4.

$\div$ is the sign of *Division;* and when placed between two numbers, shows that the *former number* is to be divided by the *latter;* thus, $6 \div 3$ means that 6 is to be divided by 3.

Or you may express *Division* by drawing a line between the *divisor* and *dividend;* thus, $\frac{6}{3}$ means that 6 is to be divided by 3, as before.

$=$ denotes *equality,* or *equal* to; and when placed between numbers, shows that they are equal to one another: thus, $2 + 2 = 4$; $3 \times 4 = 12$; $8 \div 4 = 2$, &c.

—— This line is called a *vinculum,* a Latin word signifying a bond or tie; when it is placed over two or more quantities, it shows that they are all to be joined together: thus, $\overline{4 + 3} - 2 = 5$, shows that 4 and 3 are to be *added* before 2 is subtracted from the sum; and $\overline{4 \times 3} + 4 = 16$, denote that 4 and 3 are to be *multiplied* before 4 is added.

LAVINIA.

Are these all the signs made use of in Arithmetic?

CONSTANTIA.

No: there are others applicable to the higher branches of Arithmetic; but, till you understand something of the rules to which they are applied it is useless to explain them, therefore I will do it in the proper place. But there are *terms* made use of, which I think you are capable of understanding before we proceed to other rules; such are the following: —

1. *Arithmetic* is the art of calculation; and may be done by whole numbers and fractions, *vulgar* or *decimal.*

2. *Number* is a *unit* or *one* of any thing; or it may comprehend a *collection* of things in itself, as a ship, a house, &c., but a number which is higher in *name,* is not always greater in *value:* for instance, 5 *pence* is of less value than 4 *shillings.*

3. A *whole number* is made up of one or more units, as 2, 4, are made up of *two* units and *four* units.

4. A *mixed number* is a whole number, with a part or parts annexed, as $2\frac{1}{4}$, $4\frac{1}{2}$, &c.

5. An *even number* is one that you can divide into two equal whole numbers, as 8, which you can divide by 2, without a remainder.

6. An *odd number* is that which you cannot divide into two equal whole numbers, as 3, 7, 11, &c.

7. A *prime number* is that which can only be divided by itself, or by a unit, without any remainder; and numbers are considered *prime* to each other, when only a unit will divide them, without a remainder.

8. A *square number* is the product of a number

multiplied into itself, as $2 \times 2 = 4$; $4 \times 4 = 16$; here 4 is the square of 2, and 16 the square of 4. And in the measure of any thing that has too *opposite* sides and ends equal, for instance, your mamma's dressing-glass, which is 3 feet long and 2 feet wide, if you multiply the length by the width, it gives the size of the glass in square feet, which is $3 \times 2 = 6$ feet. Or, a dining-table 10 feet long and 3 feet wide, contains 30 square feet.

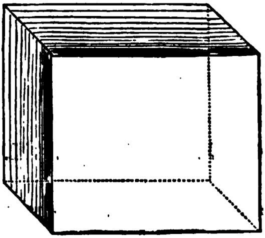
You may see this more clearly by the following diagram made upon pasteboard, which is 4 inches long, and 3 inches wide; and consequently contains 12 square inches.

1	2	3	4
5	6	7	8
9	10	11	12

9. A *cube number*, is a number multiplied into its square, as $2 \times 2 \times 2 = 8$, and $4 \times 4 \times 4 = 64$: here 8 is the cube of 2, and 64 is the cube of 4.

Sometimes a small figure is placed above a number when it is to be cubed or squared; thus, 4^2 denotes that 4 is to be *squared*, and 4^3 that the number is to be *cubed*.

A regular *cube* is of the following form, and has 6 equal sides: —



10. A *composite number* is one that is produced by multiplying two or more together; thus, 8 is a composite number of 4 and 2.

11. An *aliquot* part is that which is contained in another a particular number of times; as, *four* pence is an aliquot part of a shilling, because it is contained in it 3 times without a remainder.

12. An *integer* is one of any whole quantity or number, as one *guinea*, one *shilling*, one *pound*, one *ton*, &c.

13. *Digits* or *figures* are the characters by which you express numbers, and are as follow: 1 one, 2 two, 3 three, 4 four, 5 five, 6 six, 7 seven, 8 eight, 9 nine, and 0 cipher or nought.

14. *The object of all Arithmetic* is to find out quantities *not known*, by some which are given, and *already known*.

15. A *proposition* is something proposed to be done or proved.

16. An *axiom* is self-evident, and cannot be plainer by any means, as 2 and 2 make four.

CONVERSATION IX.

ON MONEY, WEIGHTS, AND MEASURES.

CONSTANTIA.

WELL, you have now finished all the simple rules, Lavinia; it is necessary, before you proceed further, to learn the tables, so that you can repeat them without a book. I have much to say at a future time that will interest you on money, weights, &c., the history of which is particularly interesting and instructing.

LAVINIA.

I am sure I shall be very much pleased with any thing you may say on this head: for the other day, when at Mrs. Orlando's, she showed my Mamma a box full of very curious coins, and told us an interesting anecdote about one found by their gardener while digging to plant a tree; he had no sooner found it than he ran off and presented it to Miss Rebecca, Mrs. Orlando's youngest daughter, who was always a favourite with him, and whom Miss Rebecca valued much, as the good old man never failed to supply her with a pretty *bouquet* *, every morning from the greenhouse; and took great care always to have some choice flowers for the little spot which she occupied as her own flower-garden. "There, Miss," said he, with a generous and benevolent smile, "I have found a piece of silver which I shall give to you; it looks like money, and the butler says it is one of King Charles's half-crowns; but," said he, innocently, "I do not think it money, Miss, for it would have the King's name on it; and there is only 'CAROLUS REX' upon it. I am nearly seventy-two, ma'am," said the simple-hearted gardener to Mrs. Orlando, "and I never heard of such a king in these parts." Mrs. Orlando was exceedingly amused, and said, "James, it is customary to put the name of the sovereign on money in Latin, and 'CAROLUS REX' means King Charles."—"Thank you, ma'am," said the old man, with a smile; and returned to his work, leaving the family heartily amused at his simplicity.

CONSTANTIA.

Well, the tale is very simple and interesting, my dear. The following are some of the most important tables:—

---

* Bouquet is the French word for nosegay.

FARTHINGS TABLE.

		d.			*s.*	*d.*
4	**Farthings make**	1	27	**Farthings make**		6¾
5	... ...	1¼	28	... ...		7
6	... ...	1½	29	... ...		7¼
7	... ...	1¾	30	... ...		7½
8	... ...	2	31	... ...		7¾
9	... ...	2¼	32	... ...		8
10	... ...	2½	33	... ...		8¼
11	... ...	2¾	34	... ...		8½
12	... ...	3	35	... ...		8¾
13	... ...	3¼	36	... ...		9
14	... ...	3½	37	... ...		9¼
15	... ...	3¾	38	... ...		9½
16	... ...	4	39	... ...		9¾
17	... ...	4¼	40	... ...		10
18	... ...	4½	41	... ...		10¼
19	... ...	4¾	42	... ...		10½
20	... ...	5	43	... ...		10¾
21	... ...	5¼	44	... ...		11
22	... ...	5½	45	... ...		11¼
23	... ...	5¾	46	... ...		11½
24	... ...	6	47	... ...		11¾
25	... ...	6¼	48	... 12*d.* or	1	0
26	... ...	6½				

I must not omit to tell you here, that you will frequently meet with £ *s.* *d.* *q.* over money; these are taken from Latin words; the following is the meaning: —

£ denotes a pound, from the Latin, *libra*, which was the pound or unit of weight among the Romans.

s. denotes a shilling, from *solidus*.

d. denotes a penny, from *denarius*.

q. denotes a farthing, from *quadrans*.

You must not, however, consider that these terms indicate the same value in Roman money as in English, as there was a material difference; and all those pieces distinguished by the above names were of a different value at different periods among the Romans themselves.

PENCE TABLE.

d.		s.	d.	d.		s.	d.
12	Pence make	1	0	48	Pence make	4	0
13	... ...	1	1	50	... ...	4	2
14	... ...	1	2	60	... ...	5	0
15	... ...	1	3	70	... ...	5	10
16	... ...	1	4	72	... ...	6	0
17	... ...	1	5	80	... ...	6	8
18	... ...	1	6	84	... ...	7	0
19	... ...	1	7	90	... ...	7	6
20	... ...	1	8	96	... ...	8	0
21	... ...	1	9	100	... ...	8	4
22	... ...	1	10	108	... ...	9	0
23	... ...	1	11	110	... ...	9	2
24	... ...	2	0	120	... ...	10	0
30	... ...	2	6	130	... ...	10	10
36	... ...	3	0	132	... ...	11	0
40	... ...	3	4	144	... ...	12	0

SHILLINGS TABLE.

		£	s.	d.			£	s.	d.
20	make	1	0	0	140	make	7	0	0
30	...	1	10	0	150	...	7	10	0
40	...	2	0	0	160	...	8	0	0
50	...	2	10	0	170	...	8	10	0
60	...	3	0	0	180	...	9	0	0
70	...	3	10	0	190	...	9	10	0
80	...	4	0	0	200	...	10	0	0
90	...	4	10	0	210	...	10	10	0
100	...	5	0	0	220	...	11	0	0
120	...	6	0	0	230	...	11	10	0
130	...	6	10	0	240	...	12	0	0

You are to remember that a pound sterling does not *weigh* a pound; it is an imaginary one, and passes current for *twenty* shillings.

The lowest piece of money used in England is a farthing, and all accounts are kept in pounds, shillings, pence, and farthings. There has been something said about coining *half*-farthings since the reign of Queen Victoria, but they are not to appear till next year, 1844.* But, though all accounts are kept by one certain standard of coins, yet there are many others which pass for current money in business, such as the following: —

A half-sovereign	value	Ten shillings
A crown	...	Five shillings
A half-crown	...	Two shillings and sixpence
A sixpence	...	Six pence
A silver groat	...	Four pence
A half-penny	...	Two farthings

The following is a list of Coins not now in use: —

		s.	d.
A moidore.	value	27	0
A jacobus	—	25	0
A carolus	—	23	0
A mark	—	13	4
An angel	—	10	0
A noble	—	6	8
A florin	—	6	0
A tester	—	0	6

Silver coin is not a legal tender for payment of any sum above 40 shillings; and for *copper*, not more than 12 *pence.*

LAVINIA.

But is not this a very curious law? I am sure I would not refuse five pounds if any one gave it me in *pence.*

CONSTANTIA.

No, my dear, perhaps not; but this law was not made because persons would have an objection to money in small coin.—How do you suppose, amongst merchants, where many hundreds of pounds are exchanged in a day, that they would get through their business if a few troublesome creditors like to bring each £100 in *pence* to liquidate their debts? It would be impossible to get through their business, and I think you would soon be tired of carrying your five pounds worth of pennies, if you had far to go.

---

* This coin has since been issued from the Mint, but it is more a curiosity than of any utility.

There are what are called *Bank of England notes*, which represent different sums of money; these are also a legal tender in payment. I think, Lavinia, you would much rather have one of these notes than carry your bag of *pence*.

The following is the weight of some of the gold and silver coins: —

GOLD.

OLD COINAGE.

	dwts.	grs.
Guinea............weighs	5	$9\frac{39}{89}$
Half-guinea...............	2	$16\frac{64}{89}$
Seven-shilling piece.....	1	$19\frac{13}{89}$

NEW COINAGE.

	dwts.	grs.
Sovereign...............	5	$3\frac{171}{623}$
Half-sovereign........	2	$13\frac{397}{623}$
Double Sovereign....	10	$6\frac{342}{623}$
Five Sovereign piece	25	$16\frac{232}{623}$

SILVER.

OLD COINAGE.

	dwts.	grs.
Crown...........weighs	19	$8\frac{16}{31}$
Half-crown.............	9	$16\frac{8}{31}$
Shilling..................	3	$20\frac{28}{31}$
Sixpence................	1	$22\frac{14}{31}$

NEW COINAGE.

	dwts.	grs.
Crown	18	$4\frac{4}{11}$
Half-crown.............	9	$2\frac{2}{11}$
Shilling..................	3	$15\frac{3}{11}$
Sixpence................	1	$19\frac{7}{11}$

COPPER.

OLD COINAGE.

Avoirdupois.

	oz.	drs.
Two-penny piece..........	2	0
Penny.........................	1	0
Halfpenny...................	0	8
Farthing......................	0	4

COPPER.

NEW COINAGE.

	drs.
Penny	$10\frac{2}{3}$
Halfpenny....................	$5\frac{1}{3}$
Farthing.......................	$2\frac{2}{3}$

The standard of *gold* coin is composed of 22 parts of *pure* gold, and 2 parts of copper, melted together; and the current *silver* coin is composed of 11 oz. 2 dwts. of *pure* silver, and 18 dwts. of copper.

From a pound of standard gold there are coined 44½ guineas, 89 half-guineas, or 133½ seven-shilling pieces.

From the pound Troy of standard silver are coined 13⅕ crowns, 26⅖ half-crowns, 66 shillings, or 132 sixpences.

There is no difference between the degree of fineness of the metals of gold and silver in the old and new coinage, but the pound Troy of gold was formerly coined into 42½ guineas instead of 44½; and the pound of sterling silver was coined into 62 shillings, instead of 66; and every sovereign of 20 shillings value, is 20 parts out of 21 of the weight and value of a guinea; and other pieces of money in the same proportion.

The *copper* money is coined in the proportion of 24 pence to the pound avoirdupois.

The Mint price of gold is 3*l.* 17*s.* 10½*d.* per standard ounce, and silver 5*s.* 6*d.*

LAVINIA.

But I do not understand why *copper* should be mixed with gold and silver.

CONSTANTIA.

This arises from the softness of those metals in their pure and unmixed state; and the mixing of a small quantity of copper or brass with them, gives a hardness to them which they would not otherwise possess; this mixture of an inferior metal is called *alloy:* there is, however, a difference of opinion as to the quantity considered necessary for hardening the metals; but the English standard is as I have before stated to you.

The reason for using gold and silver as the most precious of metals is very obvious; for gold, when free from any mixture of an inferior kind of metal, is of so pure a nature, that however long it remains in a melted state, it never wastes from the heat of the fire; and it is of so malleable and ductile a nature, that one grain may be spread over 56 square inches of surface; it may also be drawn into wire 500 feet long; or it may be beaten into a leaf which is only 1-200,000th part of an inch in thickness. Silver is also very malleable and ductile; for it can be beaten into leaves not more than 1-10,000th part of an inch in thickness, and drawn into a wire considerably finer than a hair.

The quality of the other metals is far inferior to gold and silver in every way; for copper, tin, lead, &c., may be burned to a powder. It is, doubtless, for this reason, that nations in all ages have considered gold and silver as the most precious of metals; and have applied the use of the others to the inferior wants of mankind.

LAVINIA.

I am not at all surprised that gold and silver should be so much valued, after what you have related to me respecting them.

CONSTANTIA.

I shall now proceed to give you the tables of weights and measures generally used for the purposes of trade and commerce.

TABLES.

TROY WEIGHT.

24 grains	make	1 pennyweight	dwt.
20 pennyweights	—	1 ounce	oz.
12 ounces	—	1 pound	lb.
25 pounds	—	1 quarter of cwt. of gold or silver	
100 pounds	—	1 hundred weight of ditto	
20 hundred weight	—	1 ton of ditto	

This weight is used to weigh gold, silver, amber, and jewels, except diamonds, which are weighed by carats, 151½ of which make a pound Troy; each carat is, therefore, 3$\frac{1}{6}$ grains Troy.

Pearls are also weighed by the standard of Troy weight, but the division is into 30 grains, instead of 24, to the pennyweight; consequently there are 600 pearl grains in an ounce.

This weight is said to take its name from Troyes, a town in France, in the department of *Aube*, and to have been introduced into England by William the Conqueror; but the inhabitants of this country being dissatisfied because it contained less weight than the old Saxon pound, he gave them the present avoirdupois weight, which term signifies *to have weight*. Others, however, state that this weight was not introduced into England until the reign of Henry VII.; but most writers are of opinion that Troy weight was first used in England, and many discoveries of ancient coins, &c., confirm the opinion.

The original standards of weights and measures in England, like those of most other countries, appear to be involved in great obscurity and uncertainty; but in the reign of Edward III., in 1266, a law was made that "an English *Penny* called a *sterling*, round and without clipping, should weigh 32 wheat corns from the *midst* of the ear; and 20 *pence* to make an *ounce*; and 12 *ounces* one *pound*; and 8 *pounds* do make one gallon of *wine*; and 8 gallons of *wine* do make a London *bushel*, which is the eighth part of a *quarter*."

LAVINIA.

You have not said any thing about those short words at the end of the pennyweights, &c.

CONSTANTIA.

They are used as a short method of expressing the different denominations.

AVOIRDUPOIS WEIGHT.

16 drams	make	1 ounce
16 ounces	—	1 pound
28 pounds	—	1 quarter of a hundred weight
4 quarters or 112 lbs.	—	1 hundred weight
20 hundred weight	—	1 ton

This weight is used for weighing all sorts of coarse and drossy goods, as all grocery, bread, butter, cheese, tar, pitch, rosin, wax, tallow, hemp, &c., and all metals, except gold and silver.

LAVINIA.

But what is the difference between this weight and Troy weight?

CONSTANTIA.

The avoirdupois ounce is less than the ounce Troy; but the pound avoirdupois is greater than the *pound Troy;* for 175 *ounces* Troy are equal to 193 ounces *avoirdupois;* but 175 *Troy pounds* are equal to 144 *pounds avoirdupois;* therefore,

		oz.	dwts.	grs.	
1 lb. avoirdupois	=	14	11	16	Troy
1 ounce —	=	0	8	5½	—

and,

			oz.	drs.	
1 lb.	Troy	=	13	2·65$\frac{1}{7}$	avoird.
1 ounce	—	=	1	1·55$\frac{3}{7}$	—

therefore, 7000 grains Troy are equal to 1 lb. avoirdupois.

There are some kinds of silk weighed by the *great* pound of 24 ounces; others by the *common* pound of 16 ounces; and, in order to reduce *great* pounds to *common,* multiply by 3, and divide by 2; and to bring *common* pounds to great, multiply by 2, and divide by 3: the reason of this is, that 16 is 2 thirds of 24.

A TABLE OF MISCELLANEOUS ARTICLES WEIGHED BY AVOIRDUPOIS WEIGHT.

	lbs.
A firkin of butter	56
A firkin of soap	64
A barrel of ditto	256
A barrel of candles	120
A barrel of raisins	112
A barrel of anchovies	30
A barrel of butter	224
A pint of do.	1¼
A chest of tea	84
A bag of rice	168
A wey of cheese in Suffolk	256
Ditto in Essex	336
A gallon of train oil	9
A puncheon of prunes	1120
A fother of lead, 19½ cwt. or	2184
A stone of horseman's weight	14
——— of butcher's meat in London	8
——— do. in the country	14
A truss of straw	36
——— of new hay	60
——— of old hay	56
A load of hay	36 trusses

WOOL WEIGHT.

	lbs.
A clove	7
A stone	14
A tod	28
A wey	182
A sack	364
A last	4368
A pack	240

BREAD AND FLOUR WEIGHT.

	lbs.	oz.	drs.
A peck loaf weighs	17	6	2
A half-peck loaf	8	11	1
A quartern loaf	4	5	8
A peck of flour	14	0	0
A bushel do.	56	0	0
A sack do. or 5 bushels	280	0	0

Gross weight, includes boxes, bags, &c., in which goods are packed for the convenience and safety of carriage.

Net weight, is the weight of a package or parcel after deducting the weight of boxes, bags, &c.

APOTHECARIES' WEIGHT.

20 grains	make	1 scruple	℈
3 scruples	—	1 dram	ʒ
8 drams	—	1 ounce	℥
12 ounces	—	1 pound	lb.

Apothecaries and chemists use this weight in *mixing* their medicines, but *buy* and *sell* by *avoirdupois* weight.

The apothecaries' pound is the same as the pound Troy, only differently divided and subdivided.

CLOTH MEASURE.

2¼ inches	make	1 nail
4 nails	—	1 quarter of a yard
3 quarters	—	1 Flemish ell
4 quarters	—	1 yard
5 quarters	—	1 English ell
6 quarters	—	1 French ell

This measure is used by linen and woollen drapers. Hollands are measured by the English ell, and tapestry by the ell Flemish; but silks, tapes, calicoes, muslins, &c., are measured by the yard.

The English yard is said to have been introduced in the reign of King Henry I. in 1101, who commanded that the ancient *ulna* or arm, which answers to the Saxon *Gyrd* or girth, should be adjusted to the length of his own arm.

LONG MEASURE.

3 barley-corns	make	1 inch
4 inches	—	1 hand-breadth[*]
12 inches	—	1 foot
3 feet	—	1 yard
6 feet	—	1 fathom[†]
5½ yards, or 16½ feet	—	1 rod, pole, or perch
4 poles, or 100 links, or 22 yrds.	—	1 chain[‡]
40 poles, or 10 chains	—	1 furlong
8 furlongs, or 1760 yrds.	—	1 mile[§]
3 miles	—	1 league
60 geographical, or $69\frac{1}{10}$ statute miles	—	1 degree

NOTE. — There are other measures which come under this table, but they are not used for the common purposes of life, viz., the palm, = 3 inches; the span, = 9 inches; the cubit, = 1½ foot; the common pace, = 2 feet 6 inches; and the geometrical pace, = 5 feet.

It is probable that most nations have derived their measures from some part of the human body, as the foot, hand, palm, &c.

The fathom of a well-proportioned man is considered to equal his height; the *girth* or the *pace*, $\frac{1}{2}$ of his stature; *cubit*, $\frac{1}{4}$; the *foot*, $\frac{1}{6}$; and the *span*, $\frac{1}{8}$; the *foot* 3 times the breadth of the *hand*, and 12 times that of the *thumb*.

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[*] The hand is used for measuring the height of horses.

[†] The fathom is used for measuring *depths*; as the sea, mines, wells, &c., and in some parts of the country it is used for measuring bark, which is cut from the tree in pieces 1 yard 2 inches in length, and placed in an upright position in rows.

[‡] The chain used for measuring is called Gunter's chain, from the name of the inventor, who was a professor of mathematics in Sir Thomas Gresham's college, in the 17th century; it is 22 yards long, and consists of 100 links; each link measures 7 inches $\frac{92}{100}$ parts.

[§] Sailors use the term "Knot," when they speak of the rate of sailing, and say so many "Knots" an hour, instead of miles.

This measure is used for every thing that has length as well as breadth, height, depth, &c., and the distance of places or things from one another.

SQUARE MEASURE.

144 inches	make	1 square foot
9 feet	—	1 yard
30¼ yards	—	1 rod, pole, or perch
16 poles	—	1 chain
40 poles	—	1 rood
4 roods, or 160 rods, or 4840 yards, or 10 chains	—	1 acre
640 acres	—	1 mile
30 acres	—	1 yard of land
100 acres	—	1 hide *
40 hides	—	1 barony

CUBIC MEASURE.

1728 inches	make	1 foot
27 feet	—	1 yard
166⅜ yards	—	1 pole
64000 poles	—	1 furlong
512 furlongs	—	1 mile
40 feet of rough timber	—	1 load
50 feet of squared do.	—	1 load
42 feet	—	1 ton of shipping
324 feet	—	1 floor of earth

* There appears no certainty as to how many acres the hide contained, for some authors make it 100 acres, some only 96, and others more; from which we may gather that nothing can be positively stated; but it is probable that the hide contained a different quantity in various parts of the kingdom.

The Normans introduced what is called the *carucate*, which is supposed to be about the same quantity as the Saxon *hide;* but its correct measurement is as difficult to ascertain as the other.

All kinds of *superficial* work are measured by this measure, such as land, boards, plastering, paving, slating, tiling, flooring, partitioning, roofing, &c.

Bricklayers' work by the square of 100 feet in slating and tiling, but by the rod of 272¼ feet in brickwork; in measuring which they omit the fraction.

This measure is used only when *length* and *breadth* are given; such as the floors of rooms, or the paper of walls, &c. If you wish to know how many yards of carpet are required for a room, or what quantity of paper it takes to cover a wall, it is by this *measure you ascertain it.*

A stack of wood 12 feet long, 3 feet broad, and 3 feet deep = 108 cubit feet.

This measure is used for measuring whatever has length, breadth, and thickness, or depth, such as timber, earth, blocks of stone, and stacks of wood; also all kinds of spirits, wines, malt, &c., are gauged or measured in cubic inches by officers of the customs and excise revenues. Gas used for lighting towns is also measured by the cubic foot. I have given you the form of a cube at page 61

WINE MEASURE.

4 gills	make	1 pint
2 pints	—	1 quart
4 quarts	—	1 gallon
10 gallons	—	1 anker of brandy
18 gallons	—	1 runlet
31½ gallons	—	1 barrel or half hogshead
42 gallons	—	1 tierce
63 gallons	—	1 hogshead
84 gallons	—	1 puncheon
2 hogsheads, or 126 gals.		1 pipe or butt
2 butts, or 252 gals.	—	1 tun

This measure is used for all wines, spirits, cider, perry, mead, vinegar, honey, oil, &c.

NOTE. — *Cider* is a drink made from the juice of apples; *perry* is made from the juice of pears; and *mead* is made from honey mixed with water and fermented, and was a favourite drink among our ancestors, who called it *metheglin.*

The gallon contains 277·274 cubic inches.

ALE AND BEER MEASURE.

2 pints	make	1 quart
4 quarts	—	1 gallon
9 gallons	—	1 firkin

2 firkins or 18 gals.	—	1 kilderkin
36 gallons or 4 firkins	—	1 barrel
54 gallons	—	1 hogshead
2 hogsheads, or 108 gals.	—	1 butt
2 butts	—	1 tun

This measure is used for all malt liquors, milk, water, &c.

Formerly the wine gallon contained 231 cubic inches, and the ale gallon 282; and it is rather remarkable that they had the same proportion to one another as the Troy and avoirdupois pound have; but they have since been altered, and each contains 277·274 cubic inches to the gallon.

DRY MEASURE.

2 pints	make	1 quart
2 quarts	—	1 pottle*
2 pottles	—	1 gallon
2 gallons	—	1 peck
4 pecks	—	1 bushel
4 bushels	—	1 coom†
2 cooms, or 8 bushels	—	1 quarter
4 quarters, or 36 bushels	—	1 chaldron
5 quarters	—	1 wey, or load
2 weys	—	1 last

This measure is used for all dry goods and grain, such as wheat, barley, beans, oats, fruit, roots, sand, salt, coals, oysters, &c.

NOTE.—Potatoes are sold in the country by the sack of 3 bushels, but in London by the hundred-weight; apples and pears are also sold by the sack of 3 bushels; and a sack of flour contains 5 bushels. A sack of potatoes in London weighs 1½ cwt. or 168 lbs.

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* The pottle is not much used in the country, except for strawberries and raspberries, which are sold in small baskets holding about a pint, made for the convenience of retailers.

† This measure is common in some parts of Suffolk; but there it is customary in some districts to buy and sell by the *quarter*; and in some parts of Essex, *wheat* is sold by the *load*, and other grain by the *quarter*.

The standard bushel contains 2218·192 cubic inches; it should be made in a circular form, and measure 18·789 inches across the inside, and 8 inches deep; but they are not all confined to this depth, provided they contain the standard measure.

It is the custom in measuring grain, to use what is called a *strike*, which is in the form of a roller; sometimes it is a *flat* piece of wood; with this the measurer strikes off whatever rises above the top of the bushel.

COVENT GARDEN MEASURES.

Least punnet	1⅓ pint
Third punnet	1 quart
Second punnet	1 pottle
Quarter sieve	1 gallon
Half-sieve	1 peck
48 least punnets	1 bushel
32 third punnets	1 do.
16 second punnets	1 do.
12 large punnets	1 do.
8 quarter sieves	1 do.
4 half-sieves	1 do.
2 sieves	1 do.

COAL MEASURE.

4 pecks	make	1 bushel
3 bushels	—	1 sack
36 bushels	—	1 chaldron
21 chaldrons	—	1 score

Coals are now sold in most places by the ton of 10 sacks, each sack weighing 224 lbs.; but coke, which is made from coal, is sold in London by the chaldron of 12 sacks, or 36 bushels.

The following Table contains some information necessary to be known: —

TABLE OF NUMBERS.

A brace .... = 2
A leash .... = 3
12 articles .... = 1 dozen
13 articles .... = 1 large dozen
12 dozen .... = 1 gross
20 articles .... = 1 score
5 score .... = 1 common hundred
6 score .... = 1 long hundred
24 sheet .... = 1 quire of paper or parchment
20 quires .... = 1 ream of ditto
2 reams .... = 1 bundle
5 doz. skins of parchment = 1 roll
72 words in common law = 1 sheet
80 —— in the Exchequer = 1 sheet
90 —— in Chancery ..... = 1 sheet

Lemons, oranges, corks, buttons, and many other articles are sold by the gross; nails, tacks, &c., have 6 score to the hundred; slates for houses also are distinguished by the "long tale" of 6 score, and the "short tale" of 5 score. Deals also are sold by the long hundred.

TIME MEASURE.

60 thirds	make	1 second
60 seconds	—	1 minute
60 minutes	—	1 hour
24 hours	—	1 day
7 days	—	1 week
4 weeks	—	1 month
12 calendar months 13 lunar months	—	1 year
365¼ days	—	1 year
52 weeks	—	1 year

MOTION.

60 seconds	make	1 minute
60 minutes	—	1 degree
30 degrees	—	1 sign in the Zodiac *

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* The Zodiac is the *imaginary* path of the sun in its annual course; the signs of the Zodiac are 12 in number, which will be explained hereafter.

90 degrees	make	1 quadrant, or ¼ of a circle
4 quadrants, or 360 degrees, or 12 signs	—	1 circle

Diurnal Motion of the Earth reduced to Time.

360 degrees	24 hours
15 degrees	1 hour
1 degree	4 minutes

Annual Motion of the Earth reduced to Time.

	days,	hours,	minutes.
360 degrees	365	6	0 nearly
30 degrees, or 1 sign	30	10	30 do.
1 degree	1	0	21 do.

A *Calendar* month is the period of time allotted to each of the months in the calendar, as in January, February, &c.

A *Lunar* month is the time which the moon takes in its circuit round the earth: *Luna* is the Latin for moon.

A *Solar* month is the time in which the sun passes through a sign of the Zodiac: *Solar* is from *Sol,* the Latin for sun.

The *Solar* year is measured by the apparent revolution of the earth round the sun, and is performed in 365 days, 5 hours, 48 minutes, $51\frac{6}{10}$ seconds.

13 Months 1 day, or 52 weeks 1 day, or 365 days, make 1 year for 3 years; but every *fourth* year contains 366 days, and is called *leap* year.

The seasons of the year are produced by the *annual* revolutions of the earth round the sun:

and *day* and *night* by the *diurnal* or daily revolution of the earth on its axis.

The *annual* and *diurnal* motions of the earth are both going on at the same time, which may be illustrated by fixing your India rubber ball to a string; place a lighted candle in the room, to represent the sun; then give the ball a smart twist with one hand while you hold it in the other; during the time it is twirling, carry it round the candle: this will show you that a globe may have two motions at the same time.

The common year is divided into 12 calendar months, as under, and varies in the number of days: —

January	31	July	31
February	28	August	31
In leap year	29	September	30
March	31	October	31
April	30	November	30
May	31	December	31
June	30		

To know when *leap* year happens, divide the year by 4; if nothing remain, it is leap year; but if there be a remainder, it shows how many years since leap year.

The following lines, by Dr. Watts, which have been handed from generation to generation, cannot be rendered more simple: —

" *Thirty* days hath September,
April, June, and November,
February has *twenty-eight* alone,
All the rest have *thirty-one*,
Except in *leap* year, then's the time
February's days are *twenty* and *nine*."

SIGNS OF THE ZODIAC, AND THE TIME IN WHICH THE SUN ENTERS THEM.

NORTHERN.

♈	Aries, the Ram	March 20th.
♉	Taurus, the Bull.	April 19th.
♊	Gemini, the Twins	May 21st.
♋	Cancer, the Crab	June 22nd.
♌	Leo, the Lion	July 23rd.
♍	Virgo, the Virgin	August 23rd.

SOUTHERN.

♎	Libra, the Balance	September 23rd.
♏	Scorpio, the Scorpion	October 23rd.
♐	Sagittarius, the Archer.	November 22nd.
♑	Capricornus, the Goat	December 22nd.
♒	Aquarius, the Water-bearer	January 19th.
♃	Pisces, the Fishes	February 18th.

The *Astronomical* day begins at noon.

QUARTERLY TERMS.

Lady-day	March 25th.
Old Lady-day	April 6th.
Midsummer-day	June 24th.
Old Midsummer-day	July 6th.
Michaelmas-day	September 29th.
Old Michaelmas day	October 11th.
Christmas-day	December 25th.
Old Christmas, or Twelfth-day	January 6th.

The Cardinal, or principal points of the compass, are East, West, North, and South.

The East is where the sun *rises.*[*]

The South is the place of the sun at *mid-day* or 12 o'clock at noon.

The West is where the sun *sets.*

The North is immediately opposite to the South.

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[*] The sun does not rise and set exactly in the East and West, except at the periods of equal day and night, which is called the time of the equinoxes, and happens about the 21st of March, and the 22nd of September.

CONVERSATION X.

ON THE ORIGIN OF THE DIVISION OF TIME, MONTHS, ETC.

CONSTANTIA.

As there is something particularly interesting in the history of the different divisions of time, I think, Lavinia, you will be pleased if I relate to you a little about it.

LAVINIA.

Indeed, I shall be very much so.

CONSTANTIA.

Even before the time of Jacob, many of the ancient nations were sufficiently acquainted with the revolutions of the moon so as to be able to measure the duration of their year by them. All nations of antiquity divided their time into 7 days, or one week; being seven revolutions of the earth on its axis; and this division most undoubtedly arose from tradition respecting the creation of the world.

The division of the month would naturally arise from the moon making its appearance nearly in the same form in about twenty-eight days. And as most of the ancients tended their flocks abroad, leading a pastoral life, they would soon observe that a certain number of these revolutions of the moon would bring them again to the enjoyment of the same brilliant sun, or the pleasures and beauties of the glorious spring: this would naturally give rise to the *year*, verifying the truth of Scripture, that they should " be for signs and for seasons, and for days and years."—Genesis i. v. 14.

I have somewhere read of one of our modern astronomers, — Ferguson, whose life somewhat verifies the above remarks: — he was the son of a poor man, and early in life he was employed in watching the sheep of a farmer; during night he amused himself by studying the stars, and in the day time by making various models of wheels, &c.: he soon went into the service of another farmer who showed him much kindness; and perceiving his taste for astronomy favoured his views, and himself assisted Ferguson in making copies during the day of what he had done in the night.

Ferguson's account of the manner in which he gained his knowledge of the heavenly bodies is very amusing, and shows what difficulties may be overcome by possessing a spirit of persevering industry. He used to stretch a thread with beads upon it at arm's length, moving the beads till they hid from his eye those stars whose apparent distances he wished to measure; he then laid his thread down upon a paper and marked the stars upon it from the beads. Many difficulties occurred to him during his astronomical pursuits; and at the suggestion of Lady Dipple, sister of

Sir James Dunbar, he drew patterns for ladies' dresses, and by this means obtained money sufficient to assist the wants of his poor father, and favour the use of his thread and beads. During a long course of exertion, Ferguson, by his talents and perseverance, greatly extended the knowledge of astronomy, and contributed, by his pen, many valuable works upon different subjects to the literature of his country.

In the book of Job. chap. 38., we have reference to several of the heavenly bodies which were known at a very early period in the history of the world; and nothing is more natural than to suppose that man could not look upon the beautiful order and harmony of this glittering assemblage of revolving worlds without observing their changes, their times, and their seasons.

The calendar we have from the Romans, and was first imposed by Romulus, the founder of Rome; he divided the year into ten months, making our March the first, then April, May, June, Quintil (afterwards Julius), Sextil (afterwards called August), September, October, November, and December. To March, May, Quintil, and October he appointed 31 days each, and 30 to each of the others, making altogether 304 days.

Numa Pompilius, the second king of Rome, followed the Grecians, and allowed 12 lunar months of 30 and 29 days each, alternately, which *made 354* days; he also added January and

February to the other 10 months, and made the year to commence in January instead of March.

This arrangement of the year continued till the time of Julius Cæsar, who after the battle of Pharsalia, in which he obtained a victory over Pompey (the particulars of which you have read in your Roman history), sent to Alexandria for one Sosigenes, an Egyptian astronomer, who regulated the year according to the course of the sun, and made a calendar of 365 days, leaving out the 6 hours each year, to form a day every *fourth* year which was to be inserted in the month of February after the 24th of that month: this took place 45 years before Christ, was used the following year, and continued the same till A. D. 1592, when Pope Gregory XIII. instituted our present calendar, which was first used in England in 1752, through a motion made by the Earl of Mansfield in the House of Peers, in 1750. The Julian Calendar making the tropical year to consist of 365 days 6 hours, it exceeded the real amount by 11 minutes 12 seconds; therefore Pope Gregory considering that the year had been retarded in its progress, he arranged that the day after the 4th of October in that year should be called the 15th, and instead of adding one day every fourth year, that three of these intercalary days should be omitted in the course of 400 years in those years which are divisible by 100, but not by 400; consequently the years 1700, 1800, 1900, will have no intercalation. It is from this alteration of the calendar that we have the terms, "new style" and "old style;" and "Lady-day," "Old Lady-day," &c.

The following are the derivations of the names of the months: —

JANUARY takes its name from Janus, the most ancient King of Italy, who, after his death, was worshipped as a Roman deity; and was represented as having two or four faces: with one he was represented as an experienced sage, looking back on the past; the other beaming with youth and beauty, and looking forward with ardent hopes and joyful expectations into futurity; and with those to the right and left he viewed the passing events of mankind.

No personage could be more appropriate for the representation of this month; who viewed with the experience of life departed years, and looked forward to the opening seasons with the joyful anticipations of youth. And however we may deprecate the errors mixed up with ancient mythology, we see in them faint resemblances of many truths recorded in Scripture.

Janus is said to resemble Noah, who could survey the wreck of the old world, and look forward to the openings of the new. Janus is said to have taught mankind to plant the vine: the same is recorded of Noah.

The *Saxons* called this *Wolf-monath,* because, when prey became scarce, these devouring beasts prowled near the dwellings of man. When

Christianity was spread, they called it *Æfteryula*, or, after Christmas.

Numa gave this month 31 days, the Decemviri reduced it to 29; but Julius Cæsar restored it to the former number.

February takes its name from the Latin word *Februo*, to purify; because this month being originally the last month in the year, the Roman people offered up expiatory sacrifices for their twelve-months' sins.

The *Saxons* called this month *Sprout-kele monath*, because their kele-wort, a kind of cabbage, began to shoot; the water in which these sprouts were boiled was used as a medicine both amongst the Saxons and Romans.

Numa gave to this month 29 days; the Decemviri altered it to 28; Julius Cæsar gave it the original number; but Augustus changed it to 28.

March receives its name from Mars, the god of war, and the protecting deity of the city of Rome.

The *Saxons* called it *Rhed-monath*, because the rites of the goddess Rheda were celebrated in it: they also gave it the name of *lenet-monath*, which is literally *Spring-month.*

Romulus assigned 31 days to this month, which it has always retained.

April derives its name from the Latin word *aperire*, to open, because in this month vegetation makes a rapid progress towards opening or blossoming.

The *Saxons* called this *Eostre-monath,* in honour of their goddess, *Eostre,* and the name is perpetuated to the present time.

Nero called this month *Neroneus,* but he was such a cruel tyrant that future ages would not recognize it by that name.

Romulus assigned to this month 29 days, and Numa added one more, which it retains.

MAY receives it name *Maia,* one of the names of *Rhea,* goddess of the earth; according to some from *majores,* in honour of the Roman senators.

The *Saxons* called this month *Tri-milchi,* on account of the fresh herbage stimulating their cows, and making their milk so abundant, that they were milked three times a day. The name of May was introduced into this country by the Normans.

Romulus gave this month 31 days, which it has always retained.

The first day of this month was a day of great festivity amongst our ancestors, when every hamlet and village had its May-pole, around which the rural population met their neighbours, talked merrily of by-gone days, and danced and sung. There were also sporting wars carried on between the winter and spring party among the juveniles who attended, when *spring* always came off victorious, and the party crowned with green branches and flowers.*

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* For an interesting account of May-days, see "Knight's London."

JUNE receives its name from *Juno*, who presided over marriages and births.

The *Saxons* called it *Lida-monath*, which signifies *gentle* and *navigable;* and the season which was favourable for voyages in their frail vessels. They also called it *Weyd-monath*, because their cattle at this time began to feed (weyd) in the meadows.

Romulus assigned to this Month 30 days.

JULY, the fifth month in the Roman calendar, received the name of Quintilis, to show its position; in the Alban calendar it had 36 days. Romulus took from it 5 days, Numa reduced it to 30; but Julius Cæsar made it 31, which it now retains. Marc Antony changed its name to *July*, in honour of Julius Cæsar.

The *Saxons* called this *Hey-monath*, as this was their time for making hay. They sometimes called it *Mead-monath*, from their meads or meadows being at this time full of flowers.

AUGUST derives it name from Augustus, the Roman Emperor; it was called *sextilis*, or the 6th month in the Alban calendar, in which it had 28 days. Romulus added two, and Augustus a third, which it now retains.

The *Saxons* styled this *Barn-monath*, being the time they generally filled their barns. Sometimes they called it *Weod-monath*, or *Clothing month*, alluding to their fields being clothed with corn.

The Romans dedicated this month to Ceres, the goddess of corn.

SEPTEMBER. This month was the 7th in the Roman calendar; hence the name from *septem*, seven, and *imber*, a shower of rain, this being the commencement of the rainy season. In the Alban calendar, it had but 16 days assigned to it; Romulus increased them to 30; Julius Cæsar to 31; but Augustus reduced it to its present number.

The *Saxons* termed this *Berst-monath*, or *barley month*, and after the introduction of Christianity, denominated it *Halig-monath*, from the religious ceremonies performed in it. Sometimes it was termed *Grist-monath*, because in this month they carried their grist or new corn to the mill to be ground.

OCTOBER takes its name from *octo*, eight, and *imber*, a shower of rain; our *Saxon* ancestors called this *Wyn-monath*, or wine month, as they pressed the grapes at this time. Sometimes it was termed *Winter-fylleth*, from the near approach of winter. It was the 8th month in the Alban calendar, and had 39 days: Romulus reduced them to 31; Numa to 29, Julius and Augustus Cæsar each added 1, as it now remains.

NOVEMBER has its name from *novem*, nine, and *imber*, a shower of rain; and it is the ninth month in the Alban calendar.

The ancient *Saxons* called it *Blott-monath*, or *slaughter-month;* for in those days winter feed was so scarce in England that it was customary to kill and salt the greatest part of their winter food in this month. It is also called *Wint-monath*, or

Wind-monath, because tempestuous winds occurred about this time.

DECEMBER takes its name from *decem,* ten, and *imber,* a shower of rain, and was the 10th and last month in the Alban calendar.

This was also called by the *Saxons, Wint-monath ;* and after the introduction of Christianity, *Halig-monath* or *holy month.*

This terminates the history, my dear Lavinia, of all the months in the year, which I hope has proved both interesting and instructive to you.

LAVINIA.

Well, I really was not aware that there was so much to be said respecting the origin of our months, or I should have been afraid to trouble you ; but you have made it particularly interesting to me. Would it be giving you too much trouble to relate to me some account of the days of the week ? if not, I shall be delighted to hear you.

CONSTANTIA.

I shall feel very great pleasure in doing so ; but we will first take a walk round the garden to see if the gardener has watered the geraniums ; and we can gather Mamma a *bouquet* from the greenhouse.

LAVINIA.

Yes, let us walk a little while, Constantia ; and I will show you my flower-garden, and brother Henry's parrot, which Mr. Halford brought him when he returned from Africa.

CONVERSATION XI.

ON THE SAXON NAMES OF DAYS, ETC.

CONSTANTIA.

OUR Saxon ancestors, you must understand, Lavinia, were idolaters, and very superstitious, paying their devotions to various objects; some of them creatures of their own ignorant imagination, and others worshipped heroes who had fallen in battle and were deified; but there were seven of these deities much more adored by them than the rest, namely: — The SUN, MOON, TUISCO, WODEN, THOR, FRIGA, and SEATER; for each of these deities they appointed a particular day to worship, and consecrated it by naming the day after it; and those very names we still retain for every day in the week.

SUNDAY was called by the Saxons *sunan-daeg*, or *Sunday*, *daeg* being the Saxon word for day; it was dedicated to the SUN, which was their chief deity, as among the Persians. In the temple consecrated to the *sun*, was an idol representing the bust of a man, which was placed on a pillar, darting rays of light from his head and face; his arms were extended, and he held before his breast a wheel as a type of the circuit which the sun is represented to make round the earth.

MONDAY, or *Monan-daeg*, was devoted by the Saxons to the MOON; which was represented by a female standing on a pedestal, dressed in a long robe, having her head adorned with flowers, and holding a garment loosely round her waist in each hand.

TUESDAY, or *Tuis-daeg*, was consecrated to TUISCO; who is reported by tradition to have been the father of the Germans and Scythians, from whom the Saxons sprung, and being held in great veneration, after his death they deified him: he was represented by the figure of a venerable old man with a long white beard, standing on a pedestal, with a sceptre in his right hand, and a boar's skin thrown over his shoulders.

WEDNESDAY, or *Woden's-daeg*, was consecrated to WODEN, or ODIN, whom the northern nations considered the father of all the deities, and the god of *war;* he was represented by a figure in a martial attitude, clad in bright armour, holding in his right hand a broad and crooked sword, and in his left a shield.

THURSDAY, or *Thor's-daeg*, was devoted to THOR, the eldest son of WODEN; he was considered the god of *air, lightning,* and *thunder,* and was supplicated for fruitful seasons; he was represented as seated on a magnificent throne; his head decked with a golden crown which was adorned with twelve glittering stars, and holding in his right hand the sceptre of royalty.

FRIDAY, or *Friga's-daeg*, was consecrated to

FRIGA, or *Frea,* the wife of *Woden,* and mother of all the gods; she had the attributes of the Roman Venus; and was represented by a female holding a naked sword in her right hand, and in her left a bow.

SATURDAY, or *Seater's-daeg,* was consecrated to *Seater,* supposed to be the Roman Saturnus; he was represented by an image standing upon a pedestal on the prickly back of a fish called a *perch;* his head was bare and countenance thin; he was dressed in a long coat, confined about his waist and shoulders with a sash made of linen; and in his right hand was a pail of water in which were fruit and flowers.

This terminates all I have to say, Lavinia, on the history of the days of the week.

LAVINIA.

You really take a great deal of trouble. I never thought there was any thing so curious in the history of days.

CONSTANTIA.

There are a great many interesting facts connected with things around us, but from their being constantly before us, we do not give them a thought.

LAVINIA.

Do all nations divide their time as we do?

CONSTANTIA.

No: the *Hebrews* divided the night into *four* watches of three hours each; the *first,* from 6 to 9 in the evening; the *second,* from 9 to 12; the *third*, from midnight to 3 in the morning; and the *fourth*, to 6, or sun-rising.

The *Jews* divided their day into morning, noon, and night; and their day consisted of 12 hours, as we may learn from the passage of our Saviour, who says, "Are there not 12 hours in the day?" &c. But if they reckoned their day from sunrise to sunset, and made their hour to consist of a *twelfth* part of the time the sun was above the horizon, their hours must have varied in length at different times in the year, and their summer hours have been much longer than their winter hours. Their hours were computed from sunrise; their *third hour* divided the time between sun-rising and noon; and the *ninth hour* divided the time between noon and sunset. Sometimes, however, the Jews in later periods made use of the Roman plan of reckoning their hours, which were the same as ours; beginning at night and reckoning to noon 12 hours; and, again, from noon to midnight.

The *Chinese* reckon their days from midnight, and divide them into 12 equal parts only; therefore their hours are twice the length of our own.

To enter into further particulars, Lavinia, respecting the manner in which different nations divide their time would take too long to explain to you now, and therefore we must proceed.

CONVERSATION XII.

ON THE WEIGHTS AND MEASURES OF THE ANCIENTS.

LAVINIA.

I OFTEN meet with many weights and measures, when I am reading history, that I do not understand.

CONSTANTIA.

That is very probable, my dear, as historical writers do not generally explain the value of measures and weights among the *ancients*: however, I will endeavour to give you some information on this point, that may be the means of assisting you.

There is a considerable degree of uncertainty about the weights and measures of the ancients, and various authors have written volumes upon the subject, without coming to any certain conclusion; but I will give you a brief sketch of those which are considered the most important, beginning with the

ANCIENT WEIGHTS OF EGYPT.

From a very early period the talent appears to have been in use among the Egyptians, as well as many of the Eastern nations, to which they assigned a particular weight; but one uniform standard is not known to have existed.

The word *talent* is from *talenton,* in the Greek; which originally signified a *balance,* as the Latin, *libra,* or pound among the Romans, but latterly was used to denote the substance weighed.

The talent was the chief weight among the Egyptians; which was divided into 60 *minæ,* each *mina* into 100 *drachms,* which were equal to 86 lbs. 8 oz. 16 dwts. English Troy weight, or 83·04 grains each drachm; and each *minæ* 8304 grains Troy.

The *mina,* sometimes called the pound, was divided into 16 ounces, and they had another pound also, called the *litra,* or *ratel,* divided into 12 ounces; and was in use among the Arabians, and the inhabitants of Asia Minor: this equalled 6886 grains Troy. The *ounce* was divided into a certain number of *dirhems* of 12 carats, each 4 grains.

EGYPTIAN LONG MEASURES.

The Egyptian measures of length were the following: — A finger, a condyle, a palm, a foot, and a cubit: their cubit was not, however, reckoned, as in most countries, from the elbow to the end of the middle finger, but from the elbow to the joint of the *wrist;* and measured 13 inches of our measure. This cubit is supposed to be the one referred to in some parts of the Old Testament, and was considered a standard amongst the learned in ancient times.

			Eng. inches.
1 finger	=		0·65
2 fingers	make	1 condyle, or	1·3
2 condyles	—	1 palm	2·6
4 palms	—	1 foot	10·4
5 palms	—	1 cubit	13·0.

ANCIENT JEWISH WEIGHTS.

			grs. Troy.
1 shekel	=		218·5713
60 shekels	=	1 maneh or	13114·28
50 maneh	=	1 talent	655714·0.

The Jewish shekel of silver was worth about 9*s*. 3½d. of our money; the *gold* shekel, 18*s*. 3*d*.; a talent of *silver* about £342; a talent of *gold* about £5075; but with regard to the value of these weights of money, opinions are greatly at variance: remember, these were sums of money, not *coins*.

ANCIENT JEWISH OR SCRIPTURE LONG MEASURES.

			inches.
A digit	=		0·8763
4 digits	=	1 palm or	3·4812
3 palms	=	1 span	10·4437
2 spans	=	1 cubit	21·8875
4 cubits	=	1 fathom	87·55
2 fathoms	=	1 pole	175·1
10 poles	=	1 shoenus, or measuring line.	1751·0
A shoenus	=	145 feet English.	

Thus we find the Scriptural cubit to be nearly 22 inches.

JEWISH TRAVELLING MEASURES.

			Eng. feet,
A cubit	=		1·824
400 cubits	=	1 stadium ....or....	729·6
5 stadia	=	a Sabbath-day's journey	3648·0
10 stadia	=	1 Eastern mile.—...	7296·6
3 Eastern miles	=	1 Parasang......—...	21890·0
8 Parasangs	=	1 day's journey —...	175120·0.

A day's journey 33⅙ English miles; a Sabbath-day's journey nearly ⅔ of an English mile.

ANCIENT JEWISH DRY MEASURES.

				Eng. pints.
A grachal	=			0·0358
20 grachal	=	1 cab	or	0·716
1⅘ cab	=	1 gomor	—	1·29
3⅓ gomor	=	1 seah	—	4·3
3 seahs	=	1 ephah	—	12·9
5 ephahs	=	1 leteeh	—	64·5
2 leteeh	=	1 comer	—	129·0
A comer	=	2 bushels 1 pint English.		

ANCIENT JEWISH LIQUID MEASURES.

				Eng. pints.
A caph	=			0·5737
1⅓ caph	=	1 log	or	0·765
4 logs	=	1 cab	—	3·06
3 cabs	=	1 hin	—	10·18
2 hins	=	1 seah	—	20·16
3 seahs	=	1 bath or ephah	—	60·48
10 ephahs	=	1 homer or corus	—	605·0

ANCIENT GREEK WEIGHTS.

There were four principal weights used among the Greeks, the largest of which were the *talent*, then the *mina*, the *drachma*, and the *obolus*, whose relative values were as under:—

OBOLUS.			
6—	DRACHMA.		
600	100—	MINA.	
36000	600	60—	TALENT.

The standards of the *Attic* weights for *silver* were of the following proportions in English avoirdupois weight: —

	lbs.	oz.	grs.
Obolus	0	0	11·08
Drachma	0	0	66·5
Mina	0	15	83·75
Talent	56	15¼	100·32.

COMMERCIAL GREEK WEIGHTS.

	lbs.	oz.	grs.
Obolus	0	0	15·29
Drachma	0	0	91·77
Mina	1	4¾	93·69
Talent	75	5¾	14·69.

VALUE IN ENGLISH MONEY OF THE ATTIC DRACHMA, AND ITS DIVISIONS.

The principal silver coin in use among the Greeks, was the drachma, and its divisions, as under: —

		s.	d.	q.	
¼ Obolus	value	0	0	1·625	Eng.
½ Obolus	—	0	0	3·25	
Obolus	—	0	1	2·5	
Diobolus	—	0	3	1	
Triobolus	—	0	4	3·5	
Tetrobolus	—	0	6	2	
Drachma	—	0	9	3	
Didrachm	—	1	7	2	
Tetradrachm	—	3	3	0.	

VALUE IN ENGLISH MONEY OF THE ÆGINETAN DRACHMA.

	s.	d.	q.
½ Obolus	0	1	0·583
Obolus	0	2	1·166
Diobolus	0	4	2·33
Drachma	1	1	3
Didrachm	2	3	2.

These were the two principal standards of money in Greece; but there was one in use among the Greeks in Egypt called the Macedonian drachma, worth about 1*s.* 3*d.* in our money: other Greek weights are computed from their relation to the Attic; and the *Tyrian* talent was considered equal to the *Attic.* The Attic *talent* was worth £243 15*s.*, and the *mina,* £4 1*s.* 3*d.*; the Æginetan *talent* was worth £343 15*s.*; and the *mina,* £5 14*s.* 7*d.* of our money. The talents here mentioned only refer to *silver;* there were smaller ones for *gold,* weighing about 6 Attic drachmæ, or ¾ oz. and 71 grs. This was called the *gold* talent, or *Sicilian talent,* being used much among the Greeks in Sicily and Italy. This is the talent referred to when it occurs in the writings of the poet Homer.

LONG MEASURE OF ANCIENT GREECE.

There were two kinds of Long Measure made use of in Greece, the *Olympic* and the *Pythic;* the first was used in all the Greek cities in Italy, the Peloponnesus, Attica, and Sicily; the Pythic was used amongst the Gauls, at Marseilles, Thrace, Illyria, Phocis, and Thessaly; but both measures had the same divisions.

OLYMPIC MEASURES.

			Eng. inches.
A dactylos................	=	....	·7567
4 dactyli..................	=	1 palesta ......or	3·027
4 palestæ.................	=	1 foot..........—	12·108
1½ foot.....................	=	1 cubit ....—	18·162
10 feet......................	=	1 decapodon..—	121·08
600 feet.....................	=	1 stadium.........	7264·8
			or nearly 201¼ Eng. yards.

PYTHIC MEASURES.

				Eng. inches.
A dactylos	=			·6005
4 dactyli	=	1 palesta	or	2·442
4 palestæ	=	1 foot	—	9·768
1½ foot	=	1 cubit	—	14·652
10 feet	=	1 decapodon	—	97·680
600 feet	=	1 stadium		5860·6
		or nearly 162¾ Eng. yards.		

The Phyleterian foot is the Pythic cubit of 1½ foot. The Macedonian foot was 13·92 English inches, and the Sicilian foot of Archimedes 8·76 English inches.

ANCIENT GREEK SUPERFICIAL MEASURES.

OLYMPIC MEASURES.

36 Olympic square feet	=	1 hexapodon
64 hexapoda	=	1 hemihectos
2 hemihecti	=	1 hectos or modius
6 modii	=	1 medimnus or jugerum.

We have, therefore, 2 roods, 23 poles, English, for the Olympic jugerum.

PYTHIC MEASURES

1666⅔ square cubits	=	1 hemihectos
2 hemihecti	=	1 modius
6 modii	=	1 medimnus or jugerum

The Pythic jugerum is, therefore, 2 roods, 29 poles, English measure.

ANCIENT GREEK LIQUID MEASURES.

				Eng. pints.
A cyathus	=			0·0825
1½ cyathus	=	1 oxybathon	or	0·1237
6 cyathi	=	1 cotylus	—	0·5955
12 cyathi or 2 cotyli	=	1 xestes	—	0·9911
6 xestes	=	1 chous	—	5·9471
6 choi	=	1 amphoreus	—	35·6826
2 amphorei	=	1 metretes, or keramion		71·3652

A metretes contains 8 gallons 7·365 pints, English measure.

ANCIENT GREEK CORN MEASURES.

				Eng. pints.
A cotylus	=			0·4955
2 cotyli	=	1 xestes	or	0·9911
2 xestes	=	1 chœnix	—	1·9822
2 chœnices	=	1 hemihectcs	—	7·9288
2 hemihecti	=	1 hectos	—	15·8576
6 hecti	=	1 medimnus.		

The medimnus here used for calculation contained 11 gallons 7·1456 pints English.

ANCIENT ROMAN WEIGHTS.

The *siliqua* appears to have been the smallest weight in use among the Romans, and their *libra*, or pound, the principal weight, which they divided into 12 parts, called *unciæ*. The table below gives the weight in ounces and grains, avoirdupois: —

		Unciæ		oz.		grs. dec.
Libra	=	12	...	11¾	...	60·45
Deunx.	=	11	...	10¾	...	64·54
Dextans or decuncis	=	10	...	9¼	...	38·50
Dodrans	=	9	...	8¼	...	42·57
Bes or bessis	=	8	...	7¾	...	76·75
Septunx	=	7	...	6¾	...	80·88
Semis or semissis	=	6	...	5¾	...	84·95
Quincunx	=	5	...	4½	...	89·05
Triens	=	4	...	3¾	...	93·14
Quadrans or Teruncius	=	3	...	2¾	...	97·21
Sextans	=	2	...	1¾	...	101·29
Sescuncia or sescunx	=	1½	...	1¼	...	103·624
Uncia	=	1	...	0¾	...	105·36
						or 433⅔

The *uncia*, or *ounce*, among the Romans, had the following subdivisions and weights: in ounces and grains, avoirdupois: —

			oz.	grs.
2 semiunciæ	each	=	¼	107·46
3 duellæ	—	=	¼	35·82
4 sicilici	—	=	0	108·416
6 sextulæ	—	=	0	72·277
24 scrupula	—	=	0	18·069
144 siliquæ	—	=	0	3·011

When the drachma was made equal to 96 *denarii* to the pound, the *uncia* was divided as below, into, —

			grs.
8 drachmæ	each	=	54·208
24 scrupula	—	=	18·069
48 oboli	—	=	9·034
144 siliquæ	—	=	30·11

So that we find the division of the pound into twelve parts or ounces, is a very ancient custom.

The Roman *denarius* was worth 8½*d.* of our money; it consisted at one time of ten *asses*, worth 3·4 farthings each, and was divided as follow: —

	d.	q.
Teruncius	0	0·53125
Sembella	0	1·0625
Libella	0	2·125
Sestertius	2	0·5
Quinarius, or Victoriatus	4	1
Denarius	8	2

The Roman *As* was originally of the weight of the *libra*, and its divisions the same: —

	oz.
As or Libra =	12
Deunx	11
Dextans	10
Dodrans	9
Bes	8
Septunx	7
Semis	6 or half a lb
Quincunx	5
Triens	4
Quadrans	3 or a quarter of a lb.
Sextans	2
Sescunx or sescuncia	1½
Uncia	1

The Romans reckoned their money chiefly by *sesterces*. The *sestertius* was a coin worth one *fourth* of the *denarius*. The sum of one thousand *sestertii* was called a *sestertium;* the *sestertium* was not a *coin,* but a *sum* of money: in payment of large sums the Romans used the *denarius.* The value of the sestertium was as under: —

		£	*s.*	*d.*	*q.*
Sestertius	=	0	0	2	0·5
Sestertium	=	8	17	1	0

But the value of it was afterwards reduced, and the *sestertius* was worth 1*d.* 3·5 farthings, and the *sestertium* 7*l.* 16*s.* 3*d.*

ANCIENT ROMAN LONG MEASURES.

The foot was the basis of all other measures amongst the Romans, and was equal to 11·6496 inches English. It was divided as follow: —

	parts of a foot.	feet.	inches.
Digitus	$\frac{1}{16}$	0	·7281
Uncia	$\frac{1}{12}$	0	·9708
Palma	$\frac{1}{4}$	0	2·9124
Pes	1	0	11·6496
Palmipes	$1\frac{1}{4}$	1	2·5620
Cubitus	$1\frac{1}{2}$	1	5·4744

ANCIENT ROMAN ITINERARY MEASURES.

	Pedes	yds.	feet.	inches.
Pes	1	0	0	11·6496
Gradus	$2\frac{1}{2}$	0	2	5·124
Passus	5	1	1	10·248
Decempeda	10	3	0	8·496
Actus	120	38	2	5·952
Mille passus or Milliarium	5000	1618	0	—

Hence the Roman mile was 5000 feet, or 1618 yards, being 142 yards less than the English mile.

I think, Lavinia, from what I have stated to you, that you will be able to understand most of the *principal weights* and measures amongst the

Romans; their various names are very numerous, and authors have opinions much at variance among themselves about their separate value.

LAVINIA.

I feel that I am under great obligation to you, for having made this subject so easy for me to comprehend.

CONVERSATION XIII.

ON THE ORIGIN OF MONEY, ETC.

CONSTANTIA.

WELL, Constantia, we have finished those difficult names you have had so much trouble about; and we are come to a subject which I hope will be more interesting to you, and not without profit, as I intend to fulfil my promise to you in giving you a short account of the history of money.

LAVINIA.

Thank you. I am sure it will gratify me, and I shall profit by your exertions.

CONSTANTIA.

In the book of Ecclesiastes, chap. x. 19., Solomon says — " A feast is made for laughter, and wine maketh merry; but *money* answereth all things."

Like everything else, money has undergone many changes since the early ages of mankind. It is considered, that in those periods a certain value was fixed upon one article, and given in exchange for another. In the Bible we find frequent *references to cattle as* constituting a part of the wealth of an individual. After the trials of Job, we find "there came unto him all his brethren, and all his sisters, and all they that had been of his acquaintance before, and did eat bread with him in his house: and they bemoaned him and comforted him over all the evil that the Lord had brought upon him: every man also gave him a piece of money, and every one an earring of gold. So the Lord blessed the latter end of Job more than his beginning: for he had fourteen thousand sheep, and six thousand camels, and a thousand yoke of oxen, and a thousand she asses." — Job, chap. xlii.

But from the most remote ages we find that gold and silver were considered to be of considerable importance. In the thirteenth chapter of Genesis, we find, "Abraham was very rich, in *cattle, in silver, and in gold.*" And there is no doubt but they had also a certain standard of weight for that which passed current among them as money; for when Abraham purchased the field of Machpelah of Ephron, the Hittite, "Abraham *weighed* to Ephron the silver, which he had named in the audience of the sons of Heth, four hundred shekels of silver, current *money* with the merchants." Gen. xxiii. So abundant were gold and silver in the days of King Solomon, "that all his drinking-vessels were of gold, and the vessels of the house of the forest of Lebanon, were of pure gold; none were of silver; it was nothing *accounted of* in the days of Solomon." "And the king made silver to be in Jerusalem as stones." 1 Kings, x. These are convincing proofs that the nations of remote antiquity were in possession of an abundance of gold and silver, which was chiefly brought from Asia, Nubia, Ethiopia, and Thrace. We have, however, no historical evidence to prove, that, in these early ages of mankind, they used *coined* money — this belongs to a much later period in the history of the world. But the ancients must have carried commerce and the arts to a considerable extent: for we find that Solomon made a navy of ships in Eziongeber, to fetch gold from Ophir; "*linen yarn*" is also mentioned, and was sold to the "*king's merchants at a price.*" 1 Kings, x.

It is stated by ancient writers, that silver was first coined at *Ægina,* B. C. 869; but some affirm, that it was the *Lydians* who *first* put a stamp upon silver.

Silver was not coined at Rome till B. C. 269, just before the first Punic war. The Greeks obtained their silver from the mines of Laurion; and the Romans obtained theirs from Spain.

The Romans had no coins but copper or bronze till the year I have mentioned above: sixty-two years after this, *gold* was coined amongst them. This was not the case with the Greeks, for they had very little copper money in early times, silver being their universal currency.

It is the custom now to stamp money with the head *of the sovereign*; but in former times the

Romans stamped their early copper coins with the image of cattle, whence it was called *pecunia,* from the Roman word *pecus,* which signifies cattle.

There is no certainty when gold was first coined in Greece, but it is mentioned as early as 406 years before Christ; and most of the gold money previous to that time in Greece, appears to have been brought from Persia and Macedonia.

The oldest coins of the Hebrews were mostly of copper, and were struck under the dominion of the Maccabees, 150 years before Christ.

We now come to the notice of coins in our own country. Julius Cæsar, who wrote in the camp as well as fought in the field, about two thousand years ago, in speaking of the Britons, says, that that they had no *coined* money, but that they used small pieces of copper or metal of a certain weight. Some, however, affirm that the early Britons used metal rings, several specimens of which have been found made of bronze, silver, and gold; several of these have been weighed and found to contain correct multiples of the pound Troy; which strengthens the opinion that the pound Troy was in use among the ancient Celtic nations who had also their *unsha,* to correspond with our ounce.

I have already mentioned to you that rings were presented to Job, which it is probable were a representation of money.[*] There is, however, no doubt but coins existed at a very early period in England, yet there is no certainty whether they passed current as money; there are several specimens of these coins now in existence, which are impressed with figures of horses, oxen, pigs and sheep, and some of cattle, with an ear of corn on one side, and on the other the head of some royal personage. Many of these coins have on them legends in Roman characters; many have the name of CUNOBELINUS, at full length, or abbreviated: this person is said to have lived in the time of Augustus Cæsar.

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[*] At a meeting of the British Archæological Society held in *April, 1846,* numerous specimens of ring money, in gold, silver, *brass, and iron* were laid on the table, where it was stated that

The earliest of these coins is one which bears upon it the letters SEGO; supposed to mean SEGONAX, whom Cæsar mentions as one of the four Kentish Kings who attacked the camp of the Roman when he invaded Britain. Some bear the letters CAMU and CAMUL; supposed to mean CAMULODUNUM, or Colchester, in Essex, the principal city of CUNOBELINUS, and remarkable for the great number of Roman antiquities found there. It was the birth-place of Helena, the mother of Constantine the Great, who overthrew the pagan religion of the Romans and passed an edict for the observance of the Lord's day, and to refrain from work on that day: he also set aside the cruel practice of compelling Roman convicts to fight with wild beasts. There is to this day a

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this ring money is represented in hieroglyphic paintings in Egypt, and in one instance figures are seen weighing them in a pair of scales.

place in Colchester called "Helen's Lane;" and it is said that after the death of her husband she made a pilgrimage to the Holy Land, and found there a part of the cross on which our Saviour was crucified; and it is from this circumstance that the arms of Colchester consist of a cross bearing a crown on each side. You must excuse this rambling anecdote, Lavinia; but I thought it would amuse you to know that the mother of so great a man was an English woman, and it is probable from her he received much instruction that induced him in after life to become such an enemy to paganism, and so bold a defender of the Christian religion; for we find that when he put to death Licinius, his sister's son, that Helena pleaded for him, and protested his innocence, showing the tenderness of a woman and the feelings of a mother.

LAVINIA.

I was not aware that we had any one in England who was connected so closely with those ancient Romans.

CONSTANTIA.

Perhaps not, my dear; but small as our little island may appear when you look on your map and contrast it with China, America, and Russia, you will find that, for nearly two thousand years, England has been prominently connected with all the mighty changes and revolutions of that extensive period, while her language and her laws have been made known to almost every habitable part of the globe. I shall now proceed to say something more of English coins at a later period.

The Romans, it appears, forbade the use of all money in Britain in the reign of Claudius which did not bear the Imperial stamp. At what time the use of Roman money ceased in England, history gives us no account. The earliest coins in most kingdoms of Europe were pennies with a *cross* upon them. This was in those days a favourite device, and was frequently used when the signature of a name was affixed to any deed or writing, the same as a person does now who cannot write at all.

The early Kings of Kent in the sixth century had what is called *sceattæ*, or shot money; next to this we have the *penny*, which appears in the laws of Ina, King of the West Saxons, who began his reign A.D. 688. The half of the penny was called *helfpenige*, and the farthing, or fourth part, a *feorthing*. These pennies were of silver, and were the principal money in circulation for several hundred years; brass pennies were not issued, except from the kingdom of Northumberland. In early times, the Archbishops had the power of coining moneys, and each was allowed two moneyers whose names were placed on one side of the coin. These pennies were cut into halves and quarters. In the seventh century no person was allowed to buy any thing "above the value of twenty pennies, *except within a town*, and in the presence of the chief magistrate, or two or more witnesses." And "none were allowed to exchange one thing for another, except in the presence of the Sheriff, the Masspriest, or Lord of the Manor." And "if any of the people of Kent buy any thing in the city of London, he must have two or three honest men present at the bargain."

We have the names of other coins mentioned of different values as being in use among the ancients; of these were the pound, the mark, the mancus, the ora, the shilling, the thrimsa, the sceattæ, the triens, the halfling, or halfpenny, the feorthing, or farthing, and the styca, or half farthing; there is, however, much dispute as to whether these were coins or pieces of money adjusted to a certain weight. About twenty-six years ago, a ploughman at Dorking, in Surrey, turned up a wooden box containing more than six hundred Saxon pennies, of the coinages of Ethelwolf, the son of Egbert; a great number of stycas was also found at Hexham, in Northumberland, in a brass vessel, in 1832.

There appears to have been a weight in use among the Saxons for coinage, consisting only of 5400 grains, and from the pound of this weight were coined 240 pennies, which is the present nominal value of the pound.

The *shilling*, among the Normans, was in the same relation as it is at present, 20 of which made one pound, and 12 pence one shilling. The Saxons principally reckoned their money by it; and though no Saxon shilling is known, it is the chief mode of calculation in Domesday book, where it is of the same value as now. But the shilling appears to have been of the value of 4 pence at one time, at another, 5 pence, and often amongst the Saxons it passed for 16 pence, and 20 pence.

Before coined money was much in use among our ancestors, they adopted the rude method of paying in cattle, and made laws to fix the value of certain animals: the following prices were fixed by a law of King Ethelred, in the ninth century: —

	£	s.	d.
A man or slave	1	0	0
A horse	1	10	0
A mare or colt	1	0	0
An ass or mule	0	12	0
An ox	0	6	0
A cow	0	5	0
A swine	0	1	3
A sheep	0	1	0
A goat	0	0	2

LAVINIA.

But did the Saxons sell men as slaves?

CONSTANTIA.

I am sorry to say it was a common practice among our ancestors in those rude times; but the Church, who refused to receive slaves in payment for penances, used their utmost to put it down: but cattle were frequently bequeathed to the children of a deceased person; for we read of a nobleman giving to his two daughters at his death

2000 swine; another directs 200 swine to be given to two priests "for the good of his soul;' and a third directs that a certain portion of land shall be given to the Church, provided that 200 swine are fed for the use of his wife.

When Lady de Braose had offended King John, by refusing to permit her son to be page to Isabella, his Queen, she repented of her conduct; and to reconcile Isabella, she sent her 400 cows, and a beautiful bull, all of them white as milk, except the ears, which were red.

LAVINIA.

I have heard of persons burying money in the ground: is it not a very strange thing?

CONSTANTIA.

In former times, my dear, there was not that security for property that we have now; and whenever our forefathers acquired money, they kept it in their own possession; but frequently the civil wars that were spread through various parts of the kingdom, induced many to bury their money, rather than allow their enemies to have it. In a town called Hadleigh, in Suffolk, a short time since, Archdeacon Lyall had some houses removed in order to rebuild them; and while digging up the foundation, the men found a large number of coins of the reign of Queen Elizabeth, of Philip and Mary, and the intermediate reigns to Charles I., some of whose crowns and half crowns were in great perfection.

In the village of Boxford, in the same county, there was found last year a large pot of various coins, chiefly of silver, on the premises of a Mr. Smith, who made the discovery while digging in the floor of his stable.

As it would take up too much of our time, Lavinia, to give you a history of the coinage in every reign, you must be content by my giving you a list of coins, with their value, and the reigns in which they were issued.

From the reign of William I. to Henry II., the silver penny was the principal coin in use. In the reigns of Richard I, and John, no coins were issued from the English mints, except some pence, half-pence, and farthings, which were struck in Dublin, while John was lord of Ireland. The silver penny was sometimes called a sterling.*

In 1257, King Henry III. issued a gold coin weighing 2 silver pence, and was called the "*Gold pennie,*" and was to pass for twenty pence value.

In 1278, Edward I. issued the silver *gross,* or *groat,* which means *great penny,* of four pence value, and the half-groat value two pence.

In 1344, Edward III. issued six different gold coins, — one termed the *florin,* from its being first coined at Florence in 1252; it was distinguished by two leopards, and its value was 6 shillings; the *half-florin* had on it one leopard; and the *quarter-florin* was distinguished by a helmet. Nobles of 6*s.* 8*d.* value, or half a *mark*, also, half-nobles and quarter-nobles were issued by this sovereign; and though they are now only in existence as curiosities of the antiquary, yet the legal profession appear to prefer receiving the half-noble, the noble, and the mark, in preference to our modern half crowns, crowns, and half sovereigns, as their charges are chiefly made up of Edward's coins or some multiple of them; certainly a wise practice to continue. The coins of this sovereign were the first which bore upon them the motto, *Dieu et mon droit* (God and my right), which was adopted in allusion to the claim upon the French crown.

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* The name *sterling* was given both to the silver *penny* and the *penny-weight,* and is said to be derived from the *Easterlings,* who were refiners from the Eastern parts of Germany; and who first established the standard proportion of silver, which has been called sterling ever since the time of the Saxons.

The *mark*, although made use of in moneys of account and bargains, is supposed to have been a *Danish* coin, and introduced into this country by the Danish settlers, as the first mention of it is made in a treaty between Alfred the Great and Guthrun the Danish chief, who was a powerful enemy to the king; but at last he was converted to Christianity, and at the request of Alfred was baptized: he received as his portion of the country all the eastern side of the kingdom, from the river Thames to the Humber, A.D. 878. He continued the faithful ally of Alfred for 12 years, *when he died,* and is said to have been buried in *the church of* Hadleigh, in Suffolk, where the martyr, Rowland Taylor, preached, in the reign of Edward VI., and was burned to death in the reign of Mary, 1555. The mark was considered worth 160 pence, or two thirds of a pound; which is still the legal value of it.

In 1466, Edward IV. struck two new gold coins called *angels*, and *angelots*, from the figure of Michael the Archangel, and the dragon on it; they were to pass instead of nobles and half nobles, but they were greatly inferior to them in real worth, till Henry VI. made them equal to their former value, under the name of *ryal*, which he made to pass for 10*s.* each; and *angels* of 6*s.* 8*d.* with their divisions of half and quarter.

King Henry VII. was the first who coined *shillings*, in the year 1504. There had been previous to this time a denomination of money called the *shilling*, but no coins existed of that amount among the Saxons; they had their *great* and *less scilling*, the former worth about 1*s.* 2*d.* of our money, and the latter worth about 8½*d.*; no coins, however, of that name has ever been found of the Saxon or later times. The shilling of King Henry was at first called the large *groat*; and afterwards testoons (from the French word *teste* or *tête*, the head, from its having on it the head of the King). This was the first *silver* money that we find the arms of the sovereign upon.

In this reign were coined the *Rose Rial*, or *Double Rose Noble* in 1485, from the victory *gained over Richard* III. at the battle of Bos-worth-field, called the Battle of the Roses. The double rose was valued at 20*s.*; there was also half-sovereigns and double sovereigns; and he coined George nobles of the value of 6*s.* 8*d.*, and *forty penny* pieces. The George noble received its name from its having on the reverse St. George killing the dragon.

King Edward VI., was the first English King who coined crowns, half-crowns, and sixpences for circulation, and he coined a treble sovereign.

In Queen Elizabeth's reign she coined what are called *port-cullis* dollars for the use of the East India Company, worth 4*s.* 6*d.* each.

King James I., coined pieces in gold of the respective values of 10*s.*, 5*s.*, and 2*s.* 6*d.*, called angels, half-angels, and quarter angels; he also coined in gold 20*s.* pieces, called units; the double crown, value 19*s.*; the Britain crown, value 5*s.*; and the thistle crown, value 4*s.*; and the half-crown, value 2*s.* 6*d.*; he next issued rose-rials, at 30*s.* each; spur-rials, at 15*s.* King James was the first to issue copper coinage in 1613, for general use, consisting of farthings instead of those small tokens which were made of lead and copper, and which shopkeepers and tradesmen in most towns made use of for their payments, each individual having one of his own, marked with his name and the description of trade which he followed, with the date of the year. I have seen some of these tokens *made in* brass, copper, and silver.

Oliver Cromwell had pieces coined in gold worth 50*s*. In the reign of Charles I., during his wars with the Parliament, pieces of money were issued of nothing more than bits of silver, with some rude sketch of a castle, or camp, upon it; these were called siege-pieces or obsidional money.

In the year 1662, the new gold coin called the guinea, was first struck; and received its name from being made of the gold brought from Guinea, by the African Company. On the coins of Charles II. the head was made to look to the left, the opposite direction to that in which his father's was placed; and ever since that period it has been the custom of changing the position of the head of the sovereign every reign.

In 1678, Charles coined farthings of tin, with only a small piece of copper in the middle. It was in this reign that the figure of Britannia seated, as holding dominion over the sea, having in her right hand an olive branch, and in her left a spear and a shield, first appears on the copper coinage. It is said to have been modelled from the celebrated beauty, Miss Frances Stuart, afterwards Duchess of Richmond. Charles also coined double guineas, and five-guinea pieces.

In the reign of William and Mary there were gold coins, called five-pound pieces, and forty-shilling pieces.

The coins of George I. are the first on which the motto, *Fidei defensor* (Defender of the Faith) appears; sometimes only the letters F. D. appear. In 1717, he issued, for the first time, quarter guineas.

George III. coined seven-shilling pieces in 1797, but these, and the guinea, were gradually withdrawn from circulation in 1815, when the sovereign and half sovereign were coined.

Nothing particular has occurred from that period to the present time, in the history of our coinage, Lavinia; therefore I shall now leave this part of the subject, and refer to some other matters connected with money, that may prove interesting to you.

The small pieces of money coined in silver such as the silver four-pence, three-pence, two-pence, and penny, are often called *Maundy* money, so named from the *maunds* or baskets, in which the gifts were formerly contained that were distributed amongst the poor, at Whitehall, on the Thursday before Easter. It was also called *Shere* Thursday, as men on that day would "shere theyr hedes, and clyp theyr berdes, and so make them honest against Eastre-day." It was customary on this day to give to as many poor men and women as the king was years old, a quantity of meat, ale, and wearing apparel; and to each a little leathern bag containing a silver penny, twopenny, and a three-penny piece, and shillings. Formerly, the Kings performed the ceremony of washing the feet of twelve poor men, and the Queen those of twelve poor women, in imitation of our Saviour's humility, of washing the feet of his disciples; but

King James II. was the last who performed this office in person.

The custom of the *Maundy* is very ancient; and is said to have been adopted in the time of Augustine. A curious account of it is given in the "Household Book" of the Earl of Northumberland, began in 1512, when it says, "all maner of things yerly yeven by my lorde of his maundy, ande my laidis, and his lordshippi's childeren."

The word itself is derived from the Saxon *Mand*, a hand-basket; the term is but little used in the present day, except among the milkmaids in some of the rural districts, where they apply it to the basket in which they carry their butter to market; and which they always call the "*butter-mand.*"

When our present youthful and gracious Queen Victoria came to the throne, in consequence of her being very young, she distributed alms amongst those whose names were on the list, and gave to the men and women £2 10*s.* each, and 19 silver pennies (being the age of the Queen), with many articles of clothing. In the year 1843, her charities were extremely liberal. In Passion Week, at Whitehall, she relieved above 800 poor aged and infirm individuals, many of whom had lived in very good circumstances; some of these were above 90, and one 100 years old, each receiving 5*s.* The royal Gate-alms were also given to 168 persons, at 13*s.* each. On the Thursday the alms were distributed amongst the *Maundy* men and women, 24 of each (being the age of the Queen), the yeomen of the guard attended in their ancient costume, and formed a procession from Scotland-yard. One of them carried a gold shield, which contained the alms. The clergy, gentlemen, and choristers of the Chapel Royal attended. The very Rev. the Dean of Carlisle, attended by Mr. Joseph Hanley, Secretary and Yeoman of the Almonry, and two assistants, with six children from the National School of the Parish of St. George. After each person had taken his proper station, the afternoon service commenced, with lessons and prayers suitable to the occasion; between each anthem, the women had £1 15*s.*, and their woollen and linen clothing, with shoes and stockings. Both men and women received each a *red* purse containing £2 10*s.*, and a *white* one containing 24 silver pennies, that number being the age of her most gracious Majesty.

Such is the nature of the *Maundy* custom, Lavinia; and the liberality of our Sovereign shows the good feeling and consideration which she entertains for the aged and destitute of her subjects. The Archbishop of York is Lord High Almoner.

LAVINIA.

How much I should like to see the ceremony performed!

CONSTANTIA.

Well, perhaps at a future time you may have the opportunity; but you must turn your attention a little longer to the subject of money.

We have already spoken of *coined* money, after the increase of trade among mankind in different parts of the globe. Modern times have demanded a different mode of paying money to that of paying in the coined metals, and have substituted for it the use of paper money, such as Bank-notes, promissory notes, and bills of Exchange, from one country to another, and between individuals in our own country. The first of these are issued only by persons called bankers, but the latter may pass amongst all private persons in trade. The person who draws, or orders payment of a bill of exchange, is called the *drawer;* and the person to whom the order is addressed, the *drawee.* If a person in France draws a bill upon another in England, it is a foreign bill; but if the drawer and drawee both reside in England, it is an inland bill.

LAVINIA.

I do not understand what can be the form of these bills or promissory notes.

CONSTANTIA.

You have seen, my dear, a Bank of England note. That is one form of the promissory-note, and those who issue these notes, promise to pay on demand the value of them in gold or silver, whatever may be their amount.

The promissory note among tradesmen is of the following form: —

£100 London, May 5, 1846.

I promise to pay to James Henderson, or order, the sum of One Hundred Pounds on demand, for value received.

WILLIAM BRADFIELD.

The following is the form of an inland Bill of Exchange: —

£50 London, April 16, 1846.

Two months after date, pay to me or my order the sum of Fifty Pounds, for value received.*

CHARLES WALTERS.

To Messrs. Hargrave and Co.,
Merchants, London.

But as these things are not very important to you, it is not necessary to say much about them here. It is a matter of uncertainty when or by whom this mode of transacting business was first adopted; some ascribe it to the Lombards in Italy — others, to the Jews; but most likely written orders to pay money at first suggested the convenience and security of adopting a certain rule. I will give a copy of two bills that a friend of mine sent to me, which he copied from a work written by a German, which shows they were used several hundred years ago: —

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* A bill of exchange has the name of the person who has to pay the amount written across the face of it, and where it is payable; this is called "accepting" it, and the drawer writes his *name on the* back, which is called "indorsing" it.

Al nome di Dio, Amen.

À di xxvii Aprile 1404. Pagate per questa prima di Camp: à usanza à Piero Gilberto è Piero Olivo scuti Mille à sol X Barselonesi per scuto i quali scuti mille sono per Cambio che Giovanni Colombo à grossi xxii di g' scuto & pag. à Nostro Conto & Christo vi guardi.

Antoni Quarti Sal de Bruggias.

Franc. de Prato & Comp.,
à Barcelona.

Al nome di Dio, Amen.

A di xviii di Magio 1404. Pagate per questa prima di Camb: à usanza à Piero Gilberto, & à P. de Scorpo, scuti Mille de Felippo à sola Barselonesi per scuto & pag: à Nostro Conto & Christo vi guardi

Francisco de Prato
& Comp.
à Barselona.

Ant: Quarti Sal
de Bruggias.

I shall give you some little account of how the standards of gold and silver are regulated, and that must finish our history at present.

When coins are struck at the *Mint*, a sample of them is reserved in a box called the *Pix*, to be compared with a standard piece which is kept in the Exchange for the occasion. There is a great deal of ceremony on this occasion, and it is called the *trial of the Pix*, and is performed with great exactness in the presence of the Privy Council, the officers of the Mint, and a jury of the Goldsmiths' Company.

All articles, whether gold or silver, which are of the money standard, are marked with a lion. The new gold standard is marked with the number 18, and the new sterling with a lion's head, and the figure of Britannia.

All articles of standard quality that are capable of bearing a stamp have also the initials of the maker's name, the arms of the Assay Office on them, and a letter for the date. The letter of the Goldsmiths' Company shows the date, by beginning the letters of the alphabet from 1796 progressively, to 20 letters; thus, 1816 is known by U, and then commence again. The mark of the Goldsmiths' Office is a leopard's head; the Assay Office of Edinburgh, a thistle; of Dublin, a harp; of Newcastle, three castles; of Sheffield, a crown; and of Birmingham, an anchor.

We must now begin to think of setting about our figures in good earnest, Lavinia; but I hope that these little digressions have not been lost upon you; for seeing your desire at the first was to profit by what information I could afford, I have been rather more desirous of devoting to you a greater share of attention, and to add pleasure to your instruction. Your mamma is waiting to take you out in the carriage with her to Hampton, therefore to-morrow morning we shall see what can be done to increase your progress in arithmetic. Farewell.

CONVERSATION XV.

ON COMPOUND ADDITION.

CONSTANTIA.

COMPOUND Addition is a rule by which you add together numbers and quantities of *different* denominations; and I suppose, as you have acquired a correct knowledge of all the tables I have given you, that we may now proceed to the examples which come under each one of them.

RULE.—Place down *farthings* under *farthings*, *pence* under *pence*, *shillings* under *shillings*, and *pounds* under *pounds*; then add the farthings or *lowest* denomination, and divide the sum by as many of the same name as make one of the next *greater* denomination; put down the remainder under this row, and carry the quotient to the next *higher* denomination, and proceed thus through all the denominations to the highest, which add up the same as in Simple Addition.

Examples.

(1)

£	s.	d.
124	16	9½
321	10	5¼
416	12	3½
242	17	9
17	15	3¾
95	12	6½
£1219	5	1½

In adding the above, there are 10 farthings in the first line, which I divide by 4, because 4 farthings make a penny, the next higher denomination, the remainder is 2, for which I place down one half-penny, and carry 2, which is the quotient to the pence which contain 37; I then divide 37 by 12, because it makes one shilling in the next higher denomination, and one remains; this I place under the pence, and carry 3 to the shillings: and so on with the rest.

(2)

£	s.	d.
419	16	3½
174	12	5¼
243	17	9½
610	10	0¾
342	12	9¼
403	15	2¾
796	19	8½
117	13	11¼

(3)

£	s.	d.
910	15	7½
423	16	5¼
217	18	11¾
372	13	9½
604	12	3¼
123	11	10½
745	16	2½
352	13	9¼

(4)

£	s.	d.
310	17	10½
423	15	4¼
762	19	2½
593	11	10¼
179	19	5½
247	13	7¼
109	16	9½
200	13	5¾

(5)

£	s.	d.
634	12	9
122	13	4¾
307	16	9¼
218	19	5½
342	16	3
111	11	9¾
204	14	6
840	12	8

(6)

£	s.	d.
412	17	3½
204	12	2
437	14	9¾
206	16	5½
415	11	10¼
253	15	7½
163	12	4¾
109	16	6

(7)

£	s.	d.
731	12	3
417	6	5½
609	12	3¼
142	15	4¼
754	13	9½
663	16	8
198	15	11½
312	19	8¾

(8)

£	s.	d.
400	12	3½
763	15	2¾
132	15	4¼
173	19	8½
405	12	6¾
379	18	5¼
126	11	3½
214	15	10¾

(9)

£	s.	d.
829	13	4½
143	12	3¼
604	16	9
835	13	10
617	17	1¼
423	0	10¾
172	11	0¼
835	9	6¼

(10) A GROCER'S BILL.

Mrs. Wilmott,

Bought of Edward Jones, May 16. 1843.

		s.	d.		£	s.	d.
8 lbs. Raisins	at	0	7	per lb.	0	4	8
15 lbs. Currants	at	0	6½	—	0	8	1½
12 lbs. Sugar..........................	at	0	6	—	0	6	0
2 Loaves of Sugar, wt. 36lbs...	at	0	9	—	1	7	0
13 lbs. Rice	at	0	3	—	0	3	3
5 lbs. Black Pepper	at	2	0	—	0	10	0
8 ozs. Cloves	at	1	2	per oz.	0	9	4
				Amount			

(11) A SILKMERCER'S BILL

Miss Wallace,

Bought of Swan and Edgar, June 10. 1843.

		s.	d.		£	s.	d.
9 yds. of Silk........................	at	4	6	per yard	2	0	6
12 yds. of Figured do.	at	9	4	—	5	12	0
16 yds. of Sarsenet	at	2	5	—	1	18	8
11 yds. of Satin	at	7	6	—	4	2	6
3 Scarfs, embroidered	at	5	3	each	0	15	9
10 yds. of Genoa Velvet............	at	16	4	per yard	8	3	4
12 yds. of Gros de Naples	at	4	8	—	2	16	0
				Amount			

(12) A MILLINER'S BILL.

Miss Adams,

Bought of Jane Stamford, June 16. 1842.

		s.	d.		£	s.	d.
15 yds of Ribbon	at	2	3	per yard	1	13	9
3 pairs of Kid Gloves..........	at	2	6	per pair	0	7	6
2 doz. Silk do.	at	2	3	—	2	14	0
3 Indian Fans	at	17	6	each	2	12	6
16 yds. of fine Pillow Lace.....	at	3	2	per yard	2	10	8
5 pieces of Bobbin :.............	at	0	8	per piece	0	3	4
10 pieces of Tape	at	0	2½	—	0	2	1
				Amount			

(13) A CHEESEMONGER'S BILL.

Mr. Taylor,

Bought of Gurney and Co., April 10. 1843.

	s.	d.		£	s.	d.
24 lbs. Gloucester Cheese ......at	0	7	per lb.	0	14	0
1 Cheshire do. wt. 28lbs.......at	0	9	—	1	1	0
½ firkin of Butter...............at	0	11	—	1	5	8
19 lbs. of Bacon ....at	0	7½	—	0	11	10½
7 lbs. Cambridge Butter ......at	1	2	—	0	8	2
8 lbs. Cream Cheese............at	1	1	—	0	8	8
5 doz. Eggs ....at	0	10	per doz.	0	4	2
			Amount			

(14) A LINENDRAPER'S BILL.

Mrs. Morgan,

Bought of Thomas Sewell, December 15. 1843.

	s.	d.		£	s.	d.
60 yds. of Calico ....at	0	7½	per yard	1	17	6
18 ells of Holland..................at	2	0	per ell	1	16	0
12 Damask Napkins..............at	2	9	each	1	13	0
10 yds. of Cambric.................at	7	3	per yard	3	12	6
9 yds. of Jacconet Muslin......at	1	9	—	0	15	9
14 yds. of Canvas ....at	0	11½	—	0	13	5
10 yds. of Flannel...................at	1	9	—	0	17	6
			Amount			

(15) A BUTCHER'S BILL.

Mr. Johnson,

Bought of W. Davidson.

1842.		s.	d.		£	s.	d.
Mar. 3.	Leg Mutton, wt. 9½ lbs. at	0	7½	per lb.	0	5	11¼
5.	Quarter Lamb, wt. 10lbs. at	0	11	—	0	9	2
9.	Shiver Beef, wt. 29½ lbs. at	0	8	—	0	19	8
14.	Fillet Veal, wt. 12lbs. ...at	0	10	—	0	10	0
15.	3 lbs. Beef Suet......... .at	0	8½	—	0	2	1½
22.	Leg Pork, wt. 13½ lbs. ..at	0	6½	—	0	7	3¾
29.	Sirloin Beef, wt. 20 lbs. at	0	7	—	0	11	8
				Amount			

(16) A BAKER'S BILL.

Mr. Salmon,

Bought of Samuel Piper.

1842.		£	s.	d.
Feb. 4.	1 Peck of Fine Flour	0	3	4
—	1 Fine Loaf	0	0	10
12.	1 Peck of Bran	0	0	3
17.	1 Bushel of Fine Pollard	0	2	0
19.	Paper of Biscuits	0	1	0
20.	Baking Tarts	0	0	5
—	Cakes	0	0	7
	Amount			

(17) A GREENGROCER'S BILL.

Mrs. Edwards,

Bought of John Raymond.

1842.		£	s.	d.
Mar. 3.	Onions	0	0	9
4.	1 cwt. of Potatoes	0	4	6
8.	Herbs and Celery	0	1	2
16.	Broccoli and Spinach	0	2	0
June 19.	Strawberries	0	0	9
23.	Apples and Gooseberries	0	3	5
27.	Cucumbers	0	0	8
	Amount			

(18) *A Bill of Cash Paid to different Tradesmen at the end of the Week.*

1843.		£	s.	d.
Feb. 12.	Baker's Bill	0	19	10½
	Butcher's do.	1	3	8¼
	Greengrocer's do.	0	10	11
	Cheesemonger's	0	5	7½
	Grocer's do.	1	10	9
	Linendraper's do.	0	14	6¾
	Shoemaker's do.	2	1	4
	Milkman's do	0	4	9
	Amount			

EXAMPLES IN TROY WEIGHT.

(19)

lbs.	oz.	dwt.
1	7	9
4	4	17
6	10	11
4	4	15
73	4	19
8	10	13
4	5	12
6	8	6

(20)

oz.	dwt.	grs.
7	13	12
6	10	14
9	12	17
4	16	13
7	11	14
6	19	12
7	13	6
5	9	8

(21)

oz.	dwt.	grs.
7	10	12
6	11	11
5	16	11
4	17	10
1	12	16
9	16	19
8	14	16
9	4	8

(22)

lbs.	oz.	dwt.	grs.
7	10	12	10
3	4	16	13
3	7	12	11
1	1	18	6
3	11	16	12
9	8	19	9
7	11	12	8
3	4	13	11

EXAMPLES IN AVOIRDUPOIS WEIGHT.

(23)

tons	cwt.	qr.	lbs.
7	11	1	16
1	12	3	11
3	4	1	17
3	1	2	12
7	11	1	11
6	3	2	13
3	1	2	20
4	4	3	26

(24)

tons	cwt.	qr.	lbs.
8	16	3	19
5	12	1	18
3	16	3	19
2	19	1	12
8	14	2	9
7	6	3	0
5	18	0	16
4	6	2	12

(25)

tons	cwt.	qr.	lbs.
6	12	1	16
5	4	2	14
3	9	3	13
4	3	0	10
8	4	1	19
7	2	2	16
6	0	1	23
5	3	3	15

(26)

qr.	lb.	oz.	drs.
4	14	10	10
4	14	11	9
6	11	8	3
9	10	3	5
2	8	5	4
1	16	4	6
6	13	7	2
3	9	14	13

EXAMPLES IN APOTHECARIES' WEIGHT.

(27)

lb.	℥	ʒ	℈	grs.
1	7	6	1	5
7	10	3	1	6
1	2	4	0	1
7	10	3	1	6
1	7	6	1	5
0	1	3	1	2
3	11	7	2	19
4	3	4	1	3

(28)

lb.	℥	ʒ	℈	grs.
0	3	7	2	19
0	1	2	0	0
4	0	6	2	4
7	1	3	1	0
0	1	2	0	6
7	3	4	1	2
6	1	1	2	8
8	5	3	1	0

(29)

lb.	℥	ʒ	℈	grs.
7	3	1	2	11
6	2	7	1	14
3	7	2	1	11
1	3	1	0	0
2	1	2	2	16
1	3	1	2	1
4	3	6	0	18
7	3	2	1	14

EXAMPLES IN CLOTH MEASURE.

(30)			(31)			(32)			(33)		
yds.	qrs.	nls.	E. E.	qrs.	nls.	E. Fl.	qrs.	nls.	E. Fl.	qrs.	nls.
14	1	2	63	4	3	512	5	3	421	2	3
74	2	0	24	3	2	608	3	0	18	3	2
44	3	1	17	2	1	403	2	1	69	1	1
74	1	2	18	1	2	127	1	2	153	1	1
49	2	1	15	2	1	608	0	2	214	2	2
74	1	3	34	3	0	513	3	1	602	1	2
32	0	8	42	2	3	249	4	2	194	2	1
16	2	6	19	3	1	805	2	0	83	0	3

EXAMPLES IN LONG MEASURE.

(34)			(35)			(36)			(37)		
lea.	mi.	fur.	fur.	pls.	yds.	pls.	yds.	ft.	ft.	in.	b.c.
74	1	7	47	32	5¼	73	5¼	2	64	9	1
14	1	6	24	17	4¾	25	4½	2	13	8	2
63	2	3	37	18	2½	42	3	1	14	5	1
70	1	7	86	24	3	16	4¼	1	17	4	0
69	2	3	91	32	4½	39	2¾	2	43	10	1
15	2	6	25	15	2	42	1½	1	18	9	2
24	1	0	38	10	1¾	16	3	2	25	7	1
39	0	0	43	0	3	32	2½	1	14	3	1

EXAMPLES IN SQUARE MEASURE.

(38)			(39)			(40)			(41)		
A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.
26	3	31	12	1	11	26	1	36	34	1	14
11	1	7	17	3	14	13	2	22	74	2	19
13	2	12	26	1	11	23	3	13	18	1	14
17	2	11	21	3	14	36	2	28	47	2	24
16	1	12	91	1	16	22	2	33	74	1	18
24	1	21	62	3	27	19	0	19	64	2	14
26	2	19	74	1	12	33	3	16	73	3	19
53	1	8	83	3	16	17	2	24	14	3	39

EXAMPLES IN WINE MEASURE.

(42)

tuns	hhd.	gls.
22	3	62
34	2	30
71	1	17
68	3	24
25	1	18
53	1	19
61	2	60
50	2	53

(43)

pun.	gls.	qts.
29	17	2
86	19	1
43	62	1
17	15	3
35	17	1
42	13	0
29	12	2
65	18	3

(44)

tier.	gls.	qts.
39	31	0
86	26	1
15	15	3
29	11	2
10	18	1
37	34	1
63	22	2
40	17	1

(45)

gls.	qts.	pts.
14	2	1
52	3	1
16	1	0
18	2	0
73	0	1
15	0	0
43	1	1
17	2	0

EXAMPLES IN ALE AND BEER MEASURE.

(46)

bar.	fir.	gls.
37	3	6
42	2	7
16	1	4
29	0	3
18	1	2
35	3	1
46	2	6
29	0	5

(47)

bar.	fir.	gal.
82	2	5
61	1	4
54	0	3
32	1	6
16	3	2
81	2	7
59	1	1
80	1	4

(48)

hhd.	gal.	qt.
29	42	1
86	16	0
42	39	0
17	18	1
38	50	2
55	31	3
79	49	1
34	32	2

(49)

hhd.	gal.	qt.
54	41	2
32	37	1
46	28	3
51	17	1
15	10	2
10	12	2
93	14	1
36	15	0

EXAMPLES IN DRY MEASURE.

(50)

ch.	bu.	pk.
14	29	2
61	17	3
29	16	3
34	14	1
64	15	1
28	28	0
41	31	1
25	32	2

(51)

ch.	qr.	bl.
19	1	3
24	3	1
34	1	2
54	0	0
16	2	1
23	2	0
17	1	2
18	1	2

(52)

qr.	bl.	pk.
49	6	3
32	1	2
12	7	1
54	5	0
36	4	0
17	3	1
23	5	3
29	6	2

(53)

sc.	ch.	bl.
74	18	35
37	19	32
19	17	10
47	16	9
39	13	34
74	12	9
68	18	3
38	15	10

EXAMPLES IN TIME MEASURE.

(54)			(55)			(56)			(57		
yrs.	m.	wk.	m.	wk.	ds.	ds.	hs.	m.	hrs.	min.	sec.
14	3	1	64	3	5	29	23	59	47	59	59
29	7	6	85	2	6	32	22	48	86	48	48
68	5	5	58	1	4	61	17	39	73	37	31
32	6	4	63	3	3	75	16	27	35	16	29
45	10	3	92	0	2	83	14	55	49	11	16
96	5	2	75	1	5	91	11	50	62	12	52
84	8	0	66	2	2	19	18	39	55	10	47
73	4	4	35	3	0	64	22	34	49	24	44

Promiscuous Examples for Exercise.

58. I am indebted to A. 417*l.* 16*s.* 4*d.*; to B. 125*l.* 17*s.*; to C. 294*l.* 17*s.* 6½*d.*; to D. 309*l.* 18*s.* 5*d.*; to E. 100 guineas, and to F. 90 crowns, what is my whole debt?

59. If I send my servant to market, and she lays out in sugar 1*l.* 4*s.* 10*d.*; in butter, 19*s.* 7*d.*; in tea, 1*l.* 10*s.*; in meat, 1*l.* 3*s.* 7*d.*; and pay the tax-gatherer 4*l.* 13*s.* 6*d.*; what is the amount of her outlay?

60. The value of silver coined from 1816 to 1840 inclusive, was in crowns, 462,476*l.*; in half-crowns, 3,929,804*l.*; in shillings, 5,082,264*l.*; in sixpences, 1,458,114*l.*; in fourpences, 177,062*l.*; in Maundy-money fourpences, 1,012*l.*; three-pences, 892*l.*; twopences, 742*l.*; pence, 897*l.*

61. A lady leaving England for the purpose of visiting Paris and Rome, wishes her housekeeper *to collect the bills* of the various tradesmen to

whom she is indebted and discharge the same, when she finds that she owes the butcher, 79*l.* 16*s.* 5*d.*; the baker, 31*l.* 11*s.* 3*d.*; the brewer, 17*l.* 4*s.* 6*d.*; the wine merchant, 125*l.* 17*s.* 4*d.*; the corn chandler, 22*l.* 1*s.* 8*d.*; the grocer, 75 guineas; the cheesemonger, 29*l.* 16*s.* 3*d.*; the jeweller 18*l.* 10*s.*; for rent, 120 guineas; for taxes, 22*l.* 5*s.* 10*d.*; servants' wages, &c., 74*l.* 19*s.* 6*d.*; she wishes to leave for sundry expenses during her absence, 50*l.* with the housekeeper, and to carry 300 guineas with her for travelling expenses; what sum must she draw from her banker to meet these demands?

62. The following branches of the revenue for the year ending April 5. 1843, in Great Britain, amounted to the undermentioned sums: the Excise, 1,767,373*l.*; Stamps, 1,593,126*l.*; Taxes, 142,698*l.*; Property-tax, 1,885,232*l.*; Post-office, 144,000*l.*; Crown Lands, 35,000*l.*; miscellaneous, 541,556*l.*; what was the total amount?

63. Opium, an intoxicating drug, made from the juice of white poppies in Turkey, Persia, and India, is sold to a great extent by British merchants in India, to the Chinese. In 1837 and 1838, the amount in dollars from the following places was as under:—Patna, 7,777,916 dollars; Benares, 1,731,688 dollars; Malwa, 3,995,026 dollars; what was the total amount?

64. The value of goods imported into Great Britain and Ireland as calculated from Government Reports, were in the following years as

under: — 1834, 49,952,551*l.*; in 1835, 49,362,811*l.*; in 1836, 48,911,542*l.*; in 1837, 57,737,301*l.*; in 1838, 54,737,301*l.*; in 1839, 61,268,720*l.*; what was the whole amount of these imports?

65. A person borrowed a sum of money, and paid it in various sums as follows:—at one time 60 guineas, at another, 105*l.* 10*s.*, and the remainder 25*l.*; what sum did he borrow?

66. A person had a cask of wine which he purchased of a friend, without knowing how many gallons it contained; therefore, he determined to be particular in observing the quantity which he should draw from it, which was as follows:—at Christmas, he had 15 gallons 2 quarts bottled; at Easter 9 gallons and 1 pint; at Midsummer, 12 gallons 1 quart; and on the 29th of September, which was his birth-day, there were 10 gallons, 3 quarts, and 1 pint, drawn from it, and the cask was empty—what quantity did he buy?

67. A gentleman rose early one morning, determining to make a tour on foot; he first walks from London to Windsor, a distance of 24 miles, and after looking over the ancient castle and its beautiful scenery, he muses upon the poet's description of it—

> "From the stately brow
> Of Windsor's heights, the expanse below
> Of grove, of lawn, of mead survey;
> Whose turf, whose shade, whose flowers, among
> Wanders the hoary Thames along
> His silver winding way."

From thence he walks to Slough — views the residence of that great astronomer, Sir William Herschell—his mighty telescope, and retires to an old friend's to talk over the beauties he had seen; thence he makes his way to Eton College, where so many of our great and learned men have been trained. Here he muses upon the antiquities and the grandeur of this ancient edifice, and finds himself very kindly received by the Master of the College. After seeing all the beauties of these stately edifices, he returns to Slough, and back to London by railway; how far had he travelled, supposing the distance from Windsor to Slough to be 1 mile, and from Slough to Eton 1½ mile, and from Slough to London 18 miles?

68. A gentleman bought of a silversmith, dishes, in weight 13 lb. 11 oz. 12 dwts.; plates, 35 lb. 9 oz. 7 dwts.; table-spoons, 9 lb. 4 oz. 15 dwts.; 3 silver waiters of handsome workmanship, weighing 17 lb. 10 oz. 5 dwts., and tea-spoons, weighing 5 lb. 11 oz. 19 dwts.; what weight did he buy in all?

69. A merchant bought 6 bags of hops, the weight of which were as under: — Nos. 1 and 2 weighed 2 cwt. 3 qrs. 17 lb. each; 3 and 4 weighed 2 cwt. 1 qr. 18 lb. each; 5 and 6 weighed 3 cwt. 1 qr. 17 lb. each; and he agreed to pay carriage to London by railway; what weight did he pay for?

70. A gentleman had a farm, which consisted of five fields. No. 1. contained 19 acres, 3 roods,

22 poles; No. 2., 17 acres, 1 rood, 18½ poles; No. 3. 25 acres, 0 rood, 37 poles; No. 4., 12 acres, 2 roods; and No. 5., 31 acres, 2 roods, and 12 poles: how much land did he occupy?

CONVERSATION XVI.

ON COMPOUND SUBTRACTION.

CONSTANTIA.

THIS rule, Lavinia, teaches how to find the difference of any two numbers of different denominations.

RULE. Place the less name beneath the greater, taking care that you set down those that are of the same denomination under each other, as shillings under shillings, pence under pence, and farthings under farthings.

Begin at the lowest denomination to the right hand, and subtract the under number from the upper; where the lower denomination is *greater* than the upper, add as many to the upper number as make one of the next *higher* denomination, and from this sum take the lower figure: set down the difference, and carry 1 to the next higher *name in* the under line, and subtract as you did *before.*

Proof as in Simple Subtraction.

Example.

(1)

	£	s.	d.
Borrowed - -	591	13	$7\frac{1}{2}$
Paid - - -	217	14	$8\frac{3}{4}$
Remains to be paid	373	18	$10\frac{3}{4}$
Proof - - -	591	13	$7\frac{1}{2}$

In this example, the first figure is $\frac{3}{4}$, and is greater than $\frac{1}{2}$, which is above it, therefore I borrow 4 farthings, because it makes one of the next denomination — *pence;* I carry 1 to the next figure 8, which is greater than the one above; and I borrow 12, which makes *one* of the next higher denomination — *shillings,* and add to 7 which makes 19 — from this number I subtract 9, and the remainder is 10. I then proceed in the same way with the shillings, and upon this principle you will perform every sum that comes under this rule, taking care to apply to me in every difficulty you may meet with in the Examples I shall give you.

LAVINIA.

Thank you; I shall try all I can without troubling you too much.

Examples in Money.

	(2)			(3)			(4)		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
From	961	18	7	598	14	$2\frac{1}{4}$	592	17	5
Take	719	19	$8\frac{1}{2}$	217	16	$6\frac{1}{2}$	313	17	$4\frac{3}{4}$
Remainder									
Proof									

(5)

	£.	s.	d.
From	684	12	7¾
Take	216	14	10
Remainder			

(6)

	£.	s.	d.
From	817	16	2
Take	242	17	9½
Remainder			

(7)

	£.	s.	d.
From	417	10	6½
Take	126	12	3¼
Remainder			

(8)

	£.	s.	d.
From	915	19	3¾
Take	642	17	7½
Remainder			

(9)

	£.	s.	d.
From	880	2	1½
Take	219	13	3¼
Remainder			

(10)

	£.	s.	d.
From	196	12	3¾
Take	111	11	5½
Remainder			

(11)

	£.	s.	d.
From	612	16	9¼
Take	195	11	5¼
Remainder			

(12)

	£.	s.	d.
From	333	4	4¾
Take	299	4	4½
Remainder			

(13)

	£.	s.	d
From	542	18	2¼
Take	179	16	6¾
Remainder			

(14)

	£.	s.	d.
From	41,096,748	12	7¼
Take	29,001,916	19	7½
Remainder			

(15)

	£.	s.	d.
From	34,949,421	19	9¼
Take	27,700,965	19	10¾
Remainder			

(16)

	£.	s.	d.
Borrowed	64,129	18	9
Paid at different times	1,612	16	9
	49	14	4½
	102	12	6
	39	15	10¼
	82	13	8¾
	19	11	6
	64	5	3¾
	10	0	10
Paid in all			
Not paid			

(17)

	£.	s.	d.
Lent	91,423	12	4
Received at different times	8,1[illegible]4	18	4
	614	13	6
	215	10	9
	123	1	7
	410	0	6
	165	12	10½
	189	19	11¾
	702	15	7
Received in all			
Remains due			

(18)	£.	s.	d.
Lent	34,216	16	4½
Received at various times	3,214	18	5¼
	100	19	4
	15	11	9
	297	12	6
	183	16	10
	605	10	11
	428	18	2
	194	10	10
Received in all			
Left due			

(19)	£.	s.	d.
Borrowed	81,762	12	11
Paid at different times	1,402	16	3½
	216	18	8
	343	17	6¼
	129	19	0
	921	13	8½
	816	18	10¼
	440	16	6
	218	15	4
Paid in all			
Unpaid			

TROY WEIGHT.

	(20)			(21)			(22)			(23)		
	lbs.	oz.	dwt.	oz.	dwt.	grs.	lbs.	oz.	dwt.	oz.	dwt.	grs.
From	42	10	9	62	12	10	94	2	9	62	15	16
Take	16	11	14	41	19	6	83	3	11	59	15	22
Remainder												

AVOIRDUPOIS WEIGHT.

	(24)			(25)			(26)			(27)		
	ton.	cwt.	qr.	cwt.	qr.	lbs.	qrs.	lbs.	ozs.	lbs.	oz.	dr.
From	29	17	2	88	2	17	87	15	13	35	10	15
Take	18	16	3	71	1	19	10	19	15	24	11	15
Remainder												

APOTHECARIES' WEIGHT.

	(28)			(29)			(30)			(31)		
	lbs.	℥	ʒ	℥	ʒ	℈	ʒ	℈	grs.	lbs.	℥	ʒ
From	65	4	2	29	3	0	72	0	12	47	10	4
Take	31	10	7	16	2	2	41	2	17	38	11	6
Remainder												

CLOTH MEASURE.

	(32)			(33)			(34)			(35)		
	yds.	qrs.	nls.	E. E.	qrs.	nls.	E. F.	qrs.	nls.	E. Fl.	qrs.	nls.
From	162	2	1	68	0	2	249	0	2	45	1	0
Take	63	3	1	54	3	3	76	5	3	38	2	2
Remainder												

LONG MEASURE.

	(36)			(37)			(38)			(39)		
	lea.	m.	fur.	fur.	p.	yds.	p.	yds.	ft.	ft.	in.	b.c.
From	81	2	7	38	29	3½	24	2¾	1	14	10	2
Take	5	2	6	25	18	4¼	17	1½	2	12	11	1
Remainder												

SQUARE MEASURE.

	(40)			(41)			(42)			(43)		
	a.	r.	pls.	a.	r.	pls.	a.	r.	pls.	a.	r.	pls.
From	17	1	25	141	0	32	18	1	24	42	1	39
Take	2	3	17	76	3	17	16	1	29	24	3	39
Remainder												

WINE MEASURE.

	(44)			(45)			(46)			(47)		
	tuns.	hhds.	gls.	puns.	gls.	qts.	tiers.	gls.	qts.	gls.	qts.	pt.
From	35	2	51	124	15	2	33	0	3	45	3	0
Take	17	3	52	81	22	3	17	40	3	18	0	1
Remainder												

ALE AND BEER MEASURE.

	(48)			(49)			(50)			(51)		
	brls.	firks.	gls.	brls.	firks.	gls.	hhds.	gls.	qts.	hhds.	gls.	qts.
From	15	2	5	129	1	2	243	1	3	155	1	2
Take	12	3	6	75	3	8	52	36	3	63	51	3
Remainder												

DRY MEASURE.

	(52)			(53)			(54)			(55)		
	chs.	bus.	pks.	chs.	qrs.	bus.	qrs.	bus.	pks.	sc.	chs.	bus.
From	59	28	3	42	3	2	259	3	1	14	4	10
Take	43	27	2	15	2	7	73	7	3	10	20	34
Remainder												

TIME MEASURE.

	(56)			(57)			(58)			(59)		
	yrs.	m.	w.	m.	w.	d.	d.	hrs.	min.	hrs.	min.	sc.
From	23	10	3	189	2	3	154	19	52	219	50	52
Take	21	9	2	96	0	6	102	22	58	185	57	59
Remainder												

Examples for Exercise.

60. The Princess Royal was born November 21st, 1840, and the Prince of Wales, November 9th, 1841, what will be each of their ages, supposing that they live to the return of their birth days in 1860?

61. There are two numbers, the greater of which is 485, and the less 327, what is their difference?

62. There are two numbers whose difference is 174, and the greater number 352, what is the less number?

63. A lady walked one day to the Bank of England to receive her dividend, which amounted to £142. 12*s.* 8*d.*; from thence she walked to St. Paul's Church Yard to make some purchases, which amounted to £9. 11*s.* 8*d.*, but on reckoning the money in her pocket-book, she discovered that she had only 2 Bank of England £50 notes, 3 sovereigns, and a crown left; what sum did she lose, and how much remained of her dividend, after paying £9. 11*s.* 8*d.* for the goods she had purchased?

64. A charitable lady, possessed of a considerable income, gave away to the poor of her parish 300 guineas annually: in cash, to 20 poor widows, she gave £60.; in blankets, £35.; in coals, £100. 10*s.*; in bread and meat on Christmas-day, 50 guineas; to the children of ten of the most industrious families, she gave sixpence each, which

amounted to one guinea; the remainder she gave to the Minister of the parish, for the benefit of the afflicted; what sum had he to receive after all the other demands were satisfied?

65. A gentleman possessed of an estate which contained 342 acres, determined to let out to 10 labourers 2 roods, 20 poles each, at a low rent; what quantity then remained of his estate to cultivate himself?

66. A tradesman through misfortune failed in business, to A. he was indebted £259. 16*s.* 2*d.*; to B. £147. 16*s.* 6*d.*; to C., 350 guineas; to D. £129. 10*s.*; and to E., £122. 11*s.* 9*d.*: he had by him at the time £120. 11*s.* 6*d.* in cash: his furniture, &c. was worth £276. 19*s.* 10*d.*; his stock-in-trade, and his book debts amounted to £380. 16*s.* 6*d.*; all these he delivered over to his creditors: how much did they lose by him?

67. A lady sent her servant on Saturday to pay her tradesmen's weekly bills, and gave her a £10. note; she paid the butcher, £2. 19*s.* 6*d.*; the baker, £1. 5*s.* 10*d.*; the grocer, £1. 16*s.* 8*d.*; the cheesemonger 19*s.* 4*d.*; and the milkman and greengrocer, £1. 3*s.* 6*d.*; what change had the servant to return to her mistress?

68. A gentleman bought a pair of horses and harness, with a carriage, for 350 guineas: the horses and harness he valued at 95 guineas, and the harness alone at 15 guineas and a crown: what value was fixed upon the horses, and what upon the carriage?

69. A country girl returning home from market, had 6 dozen eggs in her basket, which she carried upon her head; but on passing over a narrow bridge her foot slipped, and she fell into the water with her basket and eggs — she was however soon extricated by a good-natured farmer, who was near the spot, and took her home to his house, where she dried her clothes; when he sent her away, he jokingly said —

As you grieve for your loss, my good maiden, so much,
  And you had in your basket sixteen and a score;
When you're home, count them carefully into your hutch,
  You will there find your number, and one dozen more.

How many did she lose in the river, and what number did the farmer give her?

70. The yew tree is said to live a greater number of years than any other: in the church-yard at Gresford, in North Wales, there is one which is supposed, from calculations made on their growth, to be 1419 years old; in what year, then, was it planted?

71. After the Norman conquest, William the Conqueror had an account taken of all the lands, their owners, the value of them, and the number of tenants and serfs of various ranks and denominations; all parks, forests, cattle, &c.: this book was called "Domesday Book," and was completed in 1086; how many years is it since?

CONVERSATION XVII.

ON COMPOUND MULTIPLICATION.

CONSTANTIA.

THIS rule teaches how to find the amount of any given number of various denominations repeated any number of times, and comprehends several forms, the same as simple multiplication.

RULE I. When the multiplier is not more than 12, multiply the lowest denomination by it; divide this product by the number that makes *one* of the next higher denominations; set down the remainder under the number you have multiplied, and carry the quotient to the next higher denomination: proceed thus till every denomination is multiplied.

Example.

1. What will 4 yards of cloth cost at 9*s.* 4½*d.* per yard?

	s.	*d.*	
	9	4½	
		4	
£	17	6	Answer.

Here 4 times 2 are 8 farthings, which divide by 4 farthings, the number is one penny, and you have 2 in the quotient, and nothing remains; carry the 2 to the product of the pence, which makes 18; divide by the number of pence in one of the next higher denominations, which is shillings, the quotient will be 1, and the remainder 6, which you put down beneath, and carry 1 to the next higher name which make 37, divide this by 20, and you have one in the quotient, and 17 remains; place the 17 under the shillings, and the 1 stands for £1. The work in this rule will serve as a guide in all the following, in which I shall give you an example worked under each.

Rule II. When the multiplier is above 12, and is a *composite* number, multiply by one of the component parts first, and then that product by the other.

Example.

2. What will 15 yards of lace cost at 2*s.* 7½*d.* a yard?

Here 5 × 3 = 15, therefore 5 and 3 are the multipliers.

	s.	*d.*	
	2	7½	
		5	
	13	1½	value of *5* yards.
		3	
£1	19	4½	value of 15 yards.

LAVINIA.

Does it signify which of the numbers I use *first*, as the multiplier?

CONSTANTIA.

Not the least, for if I had multiplied first by the 3 and then by the 5, the product of the 15 yards would have been precisely the same.

Rule III. When the multiplier is *not* a composite number, find two numbers that will produce the *nearest* to the required number when multiplied together. Multiply by these numbers as before, then add or subtract the odd parts as the case may require.

Example.

3. What will 23 lbs. of wax candles cost, at 1*s.* 2½*d* per lb.?

	s.	*d.*	
	1	2½	11 × 2 + 1 = 23
		11	
	13	3½	value of 11 lbs.
		2	
£1	6	7	value of 22 lbs.
	1	2½	value of 1 lb. added.
£1	7	9½	value of 23 lbs.

Rule IV. When the multiplier consists of several hundreds, multiply the given price by 10 for ten times, by 2 tens for 100, and by 3 tens for 1000, and so on: if there be any odd numbers over, find their value by Rule 3, and add the whole together.

Example.

4. What cost 264 gallons of French brandy, at £1. 12*s.* 6*d.* per gallon?

	£.	s.	d.	
4 ×	1	12	6	
			10	
6 ×	16	5	0	value of 10
			10	
	162	10	0	value of 100
			2	
	325	0	0	value of 200
	97	10	0	value of 60
	6	10	0	value of 4
	£ 429	0	0	value of 264.

Rule. V. When the multiplier is a whole number, and a fraction added to it, as ½, ⅓, ¼. ⅕, &c., divide the *upper* line by the *under* figure of these fractions, and add the *quotient* under the product of the other numbers for the answer: but if the *upper* figure of the fractional part be greater than 1, multiply the *top* line by this *upper* figure, and divide that product by the *lower* fractional figure, and add the quotient as before.

Example.

5. What will 28½lbs. of sugar cost, at 8½*d.* per lb.?

		s.	d.	
			d.	
			8½	7 × 4 = 28
			7	
		4	11½	value of 7
			4	
2) 8½		19	10	value of 28
4¼ =			4¼	value of ½
	£1	0	2¼	value of 28½

6. What will 24¾ lbs. of Mocha coffee cost, at 2*s.* 3*d.* per lb.?

$$\begin{array}{rrrcrrrl}
 & & & & & s. & d. & \\
 & & & & & 2 & 3 & 6 \times 4 = 24 \\
 & s. & d. & & & & 6 & \\
\cline{6-7}
 & 2 & 3 & & & 13 & 6 & \text{value of } 6 \\
 & & 3 & & & & 4 & \\
\cline{2-3} \cline{5-7}
4\,) & 6 & 9 & & 2 & 14 & 0 & \text{value of } 24 \\
\cline{2-3}
 & 1 & 8\frac{1}{4} & = & & 1 & 8\frac{1}{4} & \text{value of } \frac{3}{4} \\
\cline{2-3} \cline{5-7}
 & & & & \pounds 2 & 15 & 8\frac{1}{4} & \text{value of } 24\frac{3}{4} \\
\end{array}$$

It is rather unreasonable to expect you can perform this part of multiplication, Lavinia, as you have not yet done division; therefore you can omit the examples of this rule, till you have a knowledge of the other.

The following will be applicable to all the foregoing rules:—

Examples.

7. 2 yards, at 4*s.* 9*d.*
8. 3 lbs., at 2*s.* 7½*d.*
9. 4 gallons, at 1*s.* 3*d.*
10. 5 acres, at 1*l.* 3*s.* 6*d.*
11. 6 bushels, at 14*s.* 10*d.*
12. 7 firkins, at 2*l.* 16*s.* 6*d.*
13. 8 hogsheads, at 3*l.* 12*s.* 6*d.*
14. 9 yards, at 1*l.* 14*s.* 10½*d.*
15. 10 ounces, at 1*s.* 2*d.*
16. 11 cwt., at 4*l.* 16*s.*
17. 12 ells, at 5*s.* 6*d.*
18. 12 barrels, at 1*l.* 16*s.* 4*d.*
19. 24 yards of satinnette, at 7*s.* 9*d.* per yard.

20. 36 lbs. of Stilton cheese, at 1*s.* 3*d.* per lb.

21. 45 gallons of rum, at 14*s.* 6*d.* per gallon.

22. 48 gallons of brandy, at 1*l.* 12*s.* 6*d.* per gallon.

23. 54 gallons of gin, at 19*s.* 6*d.* per gallon.

24. 5 dozen of common candles, at 6½*d.* per lb.

25. 71 lbs. of beef, at 7½*d.* per lb.

26. 89 lbs. of tea, at 3*s.* 6*d.* per lb.

27. 120 lbs. of West Indian rice, at 5*d.* per lb.

28. 132 lbs. of raisins, at 6½*d.* per lb.

29. 144 lbs. of bacon, at 6¾*d.* per lb.

30. 23 sacks of coals, at 3*s.* 2*d.* per sack.

31. 27 pints of vinegar, at 5½*d.* per pint.

32. 34 lbs. of salt, at 1½*d.* per lb.

33. 43 lbs. of potatoes, at ½*d.* per lb.

34. 59 lbs. of Turkey coffee, at 2*s.* 6*d.* per lb.

35. 64 yards of quilling net, at 3½*d.* per yard.

36. 6 dozen and four pairs of cotton stockings, at 2*s.* 3*d.* per pair.

37. 85 tons of coals, at 1*l.* 8*s.* 6*d.* per ton.

38. 93 acres of land, at 31*l.* 17*s.* 6*d.* per acre.

39. 112 sacks of flour, at 2*l.* 5*s.* 6*d.* per sack.

40. 126 barrels of beer, at 1*l.* 16*s.* 6*d.* per barrel.

41. In 47 years, each 13 months, 1 day 6 hours; how many months?

42. What is the weight of 86 chests of tea, each weighing 67 lbs. 8 ozs. 15 drs.

43. 324 yards of Irish linen, at 2*s.* 6½*d.* per yard.

44. 469 yards of calico, at 8¾*d.* per yard.

45. 527 tubs of butter, at 2*l.* 18*s.* 6*d.* per tub.
46. 635 ounces of silver, at 5*s.* 6*d.* per oz.
47. 683 ounces of gold, at 3*l.* 17*s.* 10*d.* per ounce.
48. 729 lbs. of indigo, at 6*s.* $3\frac{1}{2}$*d.* per lb.
49. 802 tons of iron, at 18*l.* 10*s.* 6*d.* per ton.
50. 1742 reams of paper, at 8*s.* 6*d.* per ream.
51. 1859 sheep, at 3*l.* 6*s.* 8*d.* each.
52. 2376 lbs. of gunpowder, at 3*s.* 6*d.* per lb.
53. $1075\frac{1}{2}$ cwt. of lead, at 1*l.* 5*s.* 6*d.* per cwt.
54. $2364\frac{1}{4}$ bales of cotton, at 15*l.* 10*s.* 6*d.* per bale.
55. $2547\frac{3}{4}$ chests of oranges, at 1*l.* 3*s.* 6*d.* each.
56. $2743\frac{2}{5}$ yards of fine lace, at 3*s.* 6*d.* per yard.
57. $3692\frac{5}{8}$ of quilling net, at $2\frac{1}{2}$ per yard.
58. $4012\frac{2}{5}$ of French cambric, at 16*s.* 6*d.* per yard.
59. $5847\frac{7}{8}$ of Scotch cambric, at 2*s.* $3\frac{1}{2}$*d.* per yard.
60. $7593\frac{11}{16}$ of fine lawn, at 3*s.* 3*d.* per yard.

BILLS OF PARCELS.

FOR EXERCISE IN COMPOUND MULTIPLICATION.

(61) James Miller, Esq.

Bought of John Fuller, London, January 2, 1846

$7\frac{1}{2}$ lbs. Hyson Tea, at 8*s.* 10*d.* per lb....................
$14\frac{1}{4}$ lbs. Green Tea, at 10*s.* 6*d.* per lb. ....
$16\frac{1}{2}$ lbs. Gunpowder, at 12*s.* 4*d.* per lb..................
13 lbs. Bohea, at 5*s.* 4*d.* per lb..........................
$18\frac{1}{2}$ lbs. Fine Green, at 13*s.* 6*d*..........................
23 lbs. of Superior Twankay, at 12*s.* 8*d*...............

£

(62) CHARLES EDWARDS, Esq.

Bought of Henry Eastwell, London, Dec. 15, 1846.

A Leg of Mutton, wt. 9½ lbs., at 7½*d.* per lb. ....
A Fillet of Veal, wt. 8¾ lbs., at 9½*d.* per lb. ....
A Buttock of Beef, wt. 39¼ lbs., at 8½*d.* per lb. ....
A Leg of Pork, wt. 12½ lbs., at 5½*d.* per lb. ....
A Loin of Lamb, wt. 6¼ lbs., at 10¾*d.* per lb. ....
A Sirloin of Beef, wt. 17½ lbs., at 6½*d.* per lb. ....

£

(63) HENRY DANIELL, Esq.

Bought of Richard Newton, London, Feb. 16, 1846.

		ozs.	dwts.	grs.		per oz.	
A Silver Teapot.......	wt.	29	10	4	at	6*s.*	3*d.*
12 Plates...............	—	18	6	5	—	5*s.*	10*d.*
18 Spoons...............	—	45	10	14	—	6*s.*	2*d.*
A Silver Waiter.......	—	23	10	0	—	5*s.*	8*d.*
1 Pair Candlesticks...	—	34	12	16	—	6*s.*	4*d.*
A Silver Inkstand....	—	23	16	5	—	6*s.*	3½*d.*

£

(64) WM. TODD, Esq.

Bought of Jas. Morrison, London, Feb. 18, 1846.

	£	*s.*	*d.*	
19 cwt. of Tobacco, at	4	16	3	per cwt.
23 cwt. of Snuff, at..................	5	12	10	per cwt.
17 cwt. of Sugar, at..................	2	12	3	per cwt.
54 cwt. of Soap, at...................	2	18	6	per cwt.
17 cwt. of Potash, at	1	12	6	per cwt.
49 cwt. of Molasses, at..............	1	15	0	per cwt.

£

(65) MISS COMPTON,

Bought of Harriet Jones, London, March 10, 1846.

123 pair of Kid Gloves, at 1*s.* 10½*d.* per pair.........
29⅜ yards of Brussels Lace, at 6*s.* 4*d.* per yard......
184¼ yards of Fine Muslin, at 3*s.* 3½*d.* per yard ......
23½ dozen of Table Napkins, at 1*l.* 8*s.* 6*d.* per doz..
17¼ yards of Aropbane Crape, at 2s. 9*d.* per yd......
34 yards of Black Lace, at 3*s.* 2*d.* per yard. ....

£

(66) Edward Harman, Esq.

Bought of Chas. Ormond & Co. London, April 4, 1846.

183½	gls. of Old Jamaica Rum,	at	0	13	6	per gl.
74	gls. of Cognac Brandy......	at	1	12	6	per gl.
53	gls. of Hollands..............	at	0	12	9	per gl.
18½	doz. of Fine Old Port......	at	2	2	6	per dz.
59	doz. of Superior Sherry	at	1	19	6	per dz.
70	doz. of Guinness's Stout ...	at	0	10	9	per dz.

£

Promiscuous Examples for Exercise.

67. A gentleman bought 9 silver tankards, weighing 2 lbs. 10 oz. 15 dwts. each; what was the weight of the whole?

68. A gentleman resident in London had to cross Waterloo Bridge twice a day for ten years, without intermission (except Sundays), and paid one penny each time of crossing; how many times did he cross the bridge, and how many pence did he pay to the gate-keepers in the time, reckoning 6 days to the week, and 52 weeks to the year?

69. The population of England increases at the rate of 1000 persons in a day; what amount is that in the year, of 365 days?

70. What will the wages of the men employed in building the New Parliament Houses, at Westminster, amount to in one year, supposing there are 40 men employed, and their wages average 5*s.* per day, reckoning 6 days to the week, and 52 weeks to the year?

71. The length of one column of letter-press in

the "Times" paper measures 21½ inches, and there are frequently 96 columns in one paper; what number of yards in length would 20,000 copies extend if each column were cut up and placed in a straight line?

72. If the wheel of a machine which has 96 teeth move another wheel which has 8 teeth, how many revolutions will the smaller wheel make in 120 revolutions of the *larger;* and how many revolutions will be made by both wheels in 365 days, supposing the larger one revolves on its axis 4 times in 24 hours or one day?

73. A person employed a certain number of men to build a wall, likewise 6 boys, to whom he paid 6 shillings per week each; the number of men was as many as *half* the number of shillings which he paid the boys weekly, and their wages were 1*l.* 5*s.* each per week; what number of men did he employ, and what were his weekly expenses to all the men and boys?

74. Under the new Post Office regulations the average number of letters posted is 750 a minute, assuming that the offices are open 12 hours a day; what number is posted in a year of 365 days, and how much money is paid for the stamps, reckoning each letter at one penny?

CONVERSATION XVIII.

ON COMPOUND DIVISION.

CONSTANTIA.

I SUPPOSE you are quite ready to enter upon the next rule, Lavinia.

LAVINIA.

Yes; quite. I have my pencil sharpened, and my slate in readiness.

CONSTANTIA.

The rule, Compound Division, shows how to divide any given compound number into a proposed number of equal parts, or to find how often one number is contained in another, of different denominations.

RULE. — Place the divisor on the left of the dividend. Divide the *highest* denomination of the dividend by the divisor; and if there be any *remainder*, reduce it to the next lower denomination, and add it to the parts of the same name in the dividend; divide this number as before, and so on with the whole of the dividend.

If the divisor be under 12, or a composite number, you may perform the work by *short* division; but if the divisor consists of an odd number or a large one, it must be done by *long* division.

If the divisor contains a fraction and whole number, multiply both the divisor and dividend by the *under* figure of the fraction, and for the *divisor* add in the *upper* figure of the fraction and proceed as above, which I shall show you by example.

Proof. — Multiply the quotient by the divisor and add in the remainder, if any.

Examples.

£ s. d.

(1.) Divide 49 18 6½ by 4.

	£	*s.*	*d.*	
4)	49	18	6½	
Quotient	12	9	7½	— 2 Remainder
			4	
Proof	49	18	6½	

(2.) Divide £128 16*s.* 4*d.* by 52.

£ s. d.
52) 128 16 4 (2
104
·24
20
52) 496 (9
468
·28
12
52) 340 (6
312
·28
4
52) 112 (½
104
·· 8 — Remainder.

£ s. d.
2 9 6½ Answer.
10
24 15 5
5
123 17 1
4 19 1
2 — 8 Remainder.
128 16 4 Proof.

Add in the remaining 8 as 8 farthings.

(3.) Divide £689 15*s.* 10*d.* by 29⅔.

29⅔
3
89)

£ s. d.
689 15 10
3
2069 7 6
178
·289
267
22
20
89) 447 (5
445
··2
12
89) 30 (0
4
89) 120 (¼
89
·31

£ s. d.
(23 5 0¼ Answer.
11
255 15 2¾
8
2046 1 10
23 5 0¼
7¾ = 31 Remdr.
2069 7 6 Proof.

	£	s.	d.	
4. Divide	47	16	8½	by 2.
5. Divide	69	11	5½	by 3.
6. Divide	129	15	10	by 4.

		£	s.	d.	
7.	Divide	470	16	$6\frac{3}{4}$	by 5.
8.	Divide	185	12	9	by 6.
9.	Divide	264	13	10	by 7.
10.	Divide	819	17	9	by 8.
11.	Divide	426	13	$5\frac{1}{4}$	by 9.
12.	Divide	173	17	6	by 10.
13.	Divide	556	19	10	by 11.
14.	Divide	840	14	$3\frac{1}{2}$	by 12.
15.	Divide	1870	15	$5\frac{3}{4}$	by 24.
16.	Divide	4129	13	10	by 28.
17.	Divide	340	18	9	by 45.
18.	Divide	1040	16	$6\frac{1}{2}$	by 120.
19.	Divide	413	13	$8\frac{3}{4}$	by 79.
20.	Divide	529	16	$3\frac{1}{2}$	by $85\frac{2}{3}$.
21.	Divide	618	17	10	by $129\frac{1}{4}$.
22.	Divide	4909	15	3	by $428\frac{3}{5}$.
23.	Divide	31872	19	9	by $593\frac{1}{16}$.

Promiscuous Examples for Exercise.

24. If 1 cwt. of hops cost 4*l.* 15*s.* 6*d.*, what is that per lb.?

25. If a tun of wine cost 75*l.* 10*s.*, what is that per gallon?

26. If a firkin of butter cost 2*l.* 18*s.* 6*d.*, what is that per lb?

27. A person bought four loaves of sugar, weight 87 lbs., for 3*l.* 10*s.* 6*d.*; what was the cost of one pound?

28. Bought $45\frac{3}{8}$ yards of lace for 3*l.* 18*s.* 6*d.*; *what cost one yard?*

29. Sugar at 3*l.* 5*s.* 4*d.* per cwt.; what is the worth of one pound?

30. Bought a piece of fine Irish linen, containing 26½ yards, for 3*l.* 10*s.* 6*d.*; what cost one yard?

31. Bought a sack of flour for 2*l.* 10*s.*; what did one peck or 14 lbs. cost?

32. If a piece of brown Holland, measuring 29¾ yards, cost 1*l.* 16*s.* 10*d.*, what was the price of a yard?

33. A person bought six pieces of fine calico which measured 24 yards each in length for 5*l.*; what was the price per yard?

34. If 152 ingots* of silver each of equal weight, weighed 2351 ozs. 10 dwts. 15 grs., what is the weight of one ingot?

35. A prize of 1000 guineas was divided amongst 126 sailors, after giving one-fifth to the officers; what did each man receive?

36. A gentleman dying left his sons the sum of 2334*l.* to be divided equally amongst them, and the share of each was 389*l.*; how many sons had he?

37. A gentleman dying bequeathed the greater part of his property to his three daughters in consequence of the large sums he had spent in the education of his two sons: the amount of his bequest was 10,000*l.*, and the names of each and

---

* *An ingot* is the name given to bars or wedges of gold and *silver by* the refiners, and is of various weights.

their respective shares were as follow: — to Adelaide, Amelia, and Rosina, he gave each $\frac{1}{4}$; to Edward he gave $\frac{2}{3}$ of the remainder, and to Charles he left the residue; what sum had each to receive?

38. A person going a journey of 2359 miles wishes to perform it in 149 days; how many miles must he travel per day to accomplish the task?

39. If a person travels from Paddington to Taunton, in Somersetshire, by the Great Western Railway, a distance of $162\frac{3}{4}$ miles in $6\frac{1}{2}$ hours, what is the rate per hour at which he travels?

40. Twenty-six wedges of gold weighing, with a due proportion of alloy, 39 lbs. 10 dwts. 16 grs. were sent to the mint to be coined into guineas; what was the weight of each wedge, admitting them equal, and how many guineas could be made from them if there was no loss, and that 1 oz. will make $3\frac{3}{4}$ guineas?

41. If a servant's wages are 12 guineas a year, what is that per week?

42. The quantity of tea consumed in Great Britain in 1836, amounted to 50,000,000 pounds, and paid duty to the amount of 4,674,535*l.*; at what rate was that per pound?

LAVINIA.

This appears to be a very useful and interesting rule, *Constantia.*

CONSTANTIA.

It is indeed so, and one that will be of importance to know all through life, so do not learn it with the idea that it will never be wanted, for you must not pursue your studies with that too common, but very erroneous, notion, that what you learn when young, is only to render you accomplished, and that your future life will not require it; all that we do is for the future, and it is the future alone that stamps the value of all present actions. I shall give you a little leisure now, as your Mamma has promised to take you this afternoon to see the "Thames Tunnel" Adieu.

CONVERSATION XIX.

ON REDUCTION.

CONSTANTIA.

We will now commence our conversations on the rule called Reduction; and, as hitherto, whatever appears difficult to you, I hope you will seek to have explained.

LAVINIA.

Thank you: I imagine I can tell you the meaning of this rule from its name, which appears to signify the art of making a quantity somewhat smaller.

CONSTANTIA.

That is its general meaning, my dear, in common conversation, when you speak of making a thing less in size or quantity, but it is not the meaning applied to it in arithmetic. The word Reduction is from the Latin word *reduco*, which signifies to lead back; therefore, reduction in this sense is to lead back any given amount of money, weight, or measure, from one name or denomination to another, without altering its value.

LAVINIA.

The word Reduction, then, means nothing more than *changing*, as used here?

CONSTANTIA.

Certainly: I think I can easily explain this to you, so that you may understand without difficulty.

If I send a servant with a sovereign in gold to be changed for silver, I shall receive 20 shillings for it: if I direct her to bring *pence*, she will bring 240; and changed for *farthings*, I should have 960.

This is called Reduction *de*scending. If I send 960 farthings, or 240 pence, or 20 shillings to be changed for a sovereign, it would be Reduction *a*scending.

In the *first* instance, a higher denomination is changed for a *lower* one; in the next, the *lower* is changed for a *higher*.

LAVINIA.

I see this very clearly. There is no alteration in the *value* of the money, only the name of it is changed; and it may consist of farthings, pence, and shillings, or other pieces of money, as you may *wish*. I suppose it is the same with weights, *measures*, and distance?

CONSTANTIA.

Yes: and all those several quantities which are named in the separate tables you have learned, may be changed for other quantities in the same manner as the sovereign, without altering their value in the least.

LAVINIA.

This is all very clear to me; but I fear, when I have examples to work, I shall find more difficulty.

CONSTANTIA.

Do not fear difficulties that are distant; but strive to overcome those that are before you. I shall always be ready to give you all necessary assistance.

LAVINIA.

Is the learning of this rule necessary to perform the rules which follow it in Arithmetic?

CONSTANTIA.

It is the case with this as with those you have already learned, and you will find, if you understand Reduction thoroughly, that you will the more easily work the rules which follow, when you see the benefit of having learned this well.

RULE I.—All *great* names are brought into *small* by *multiplying* with so many of the less as make *one of the greater* denomination.

Example.

1. Reduce £120 into shillings, pence, and farthings.

£
120
20
2400 shillings.
12
28,800 pence.
4
115,200 farthings

When there are several denominations, multiply the *highest* by so many as make one of the next *less* denomination; and add to the product each denomination that is of the same name, on the right hand.

Example.

2. Reduce £25 16*s.* 10½*d.* to shillings, pence, and farthings.

£ *s.* *d.*
25 16 10½
20
516 shillings.
12
6202 pence.
4
24810 farthings.

Rule II.—All *small* names are brought into *great by dividing* with so many of the less as make *one of* the greater.

Example.

3. Reduce 641,340 farthings to pence, shillings, and pounds.

4) 641,340
12) 160,335 pence.
2,0) 1336,1 3*d.* shillings.
£668 1*s.* 3*d.* pounds.

Bear in mind that your divisor and dividend must always be of the same name; for you cannot divide pence by farthings, nor shillings by pence, to have your work correct.

The remainder is of the same name as the dividend. In dividing by 20, cut off the cipher, in the divisor, and the last figure in the dividend.

These remarks will apply to all the variations in this rule, examples of which I shall give you, exercising all the foregoing tables in money, weights, and measures.

Examples in Money.

4. In £584 how many shillings, pence, and farthings?

5. In 643 guineas, how many shillings and pence?

6. Reduce 41,703 moidores into farthings.

7. Reduce £31 18*s.* 10$\frac{1}{2}$*d.* into half-pence.

8. In 6418 marks, how many groats?

9. In 21 *guineas,* how many nobles?

10. In £189 18*s.* 8¾*d.*, how many farthings?

11. Reduce £4430 6*s.* 8*d.* into nobles.

12. In £14,310 18*s.* 9*d.*, how many shillings and three-pences?

13. How many half-crowns are contained in a thousand guineas?

14. Reduce 789 groats into shillings and pounds.

15. Reduce 614,320,400 farthings to pence, shillings, and pounds.

16. In 41,946 dollars, at 4*s.* 6*d.* each, how many pounds?

17. Reduce 68,358 three-pences into pounds.

18. In £154 how many crowns, half-crowns, shillings, and sixpences, and of each an equal number?

19. Reduce 10,050 guineas to seven-shilling pieces.

20. How many crowns and pounds are there in 491,630 sixpences?

21. Reduce 365 marks into two-pences.

22. Reduce 32,187,642 farthings to half-crowns, crowns, and pounds.

23. Reduce 70 moidores to pounds.

24. Twenty-five men are to receive the sum of £131 5*s.* in equal portions; what number of crowns is that for each man?

25. I have 3 purses, containing gold, silver, and copper; the first has in it 42 sovereigns, 3 half-sovereigns, and 7 guineas; the second contains 12 crowns, 5 half-crowns, 10 silver groats,

and a 7-shilling piece; the third purse contains 19 pence, 15 half-pence, and 42 farthings: what number of pounds is contained in the 3 purses?

TROY WEIGHT.

26. In 14,164 lbs. how many ounces?

27. Reduce 4421 ozs. 16 dwts. to grains.

28. Reduce 29 lbs. 10 ozs. 12 dwts. to grains.

29. In 8,197,560 grains, how many pounds?

30. In 13 ingots of silver, weighing each 12lbs. 10 ozs. 15 dwts., how many lbs.?

31. A gentleman has 5½ dozen of spoons, each weighing 1½ oz.; what is the whole weight in ounces, and their value, at 5*s.* 6*d.* per ounce?

AVOIRDUPOIS WEIGHT.

32. Reduce 574 tons of copper into cwts., quarters, lbs., ozs., and drs.

33. Reduce a firkin of butter into half pounds, and quarter pounds.

34. In a barrel of butter, how many half firkins?

35. In 7 bags of hops, each weighing 2 cwts. 3 qrs. 14 lbs., how many pounds?

36. How many parcels of 1½ lb. each may be made out of a puncheon of prunes?

37. Reduce 35 cwts. 3 qrs. 0 lb. 14 ozs. to half drams.

38. In a fother of lead, how many lbs.?

39. In 584 *great* pounds of silk, how many common ones?

40. In 636 *common* pounds, how many great pounds?

APOTHECARIES' WEIGHT.

41. In 49 lbs., how many scruples and grains?

42. How many lbs. are contained in 416,940 grs.?

43. In 18 lbs. 1 ℥ 1 ʒ 2 ℈ 19 grs., how many grains?

44. Reduce 104,279 grs. to pounds.

CLOTH MEASURE.

45. Reduce 174 yards into nails.

46. In 319 English ells, how many nails?

47. In 243 French ells, how many nails?

48. In 792 Flemish ells, how many nails?

49. Reduce 513 yds. 3 qrs. 2 nls. to inches.

50. How many yards are contained in 5 pieces of Holland, each measuring 34 Flemish ells?

51. In 25 pieces of Yorkshire Kersey, each 62½ yds., how many English ells?

52. A merchant received a box of Irish linen from Coleraine, containing 24 pieces, each piece measuring 26½ yds.; how many nails are contained in the quantity?

53. In 10 pieces of fine lawn, each 6½ yds., how many quarters?

54. In 17 pieces of Scotch Cambric, each 7½ *yards, how* many inches?

LONG MEASURE.

55. In 522 miles, how many furlongs, poles, yards, feet, inches, and barleycorns?

56. In 123,200 yards, how many leagues?

57. From London to Brighton, by Railway, the distance is 50½ miles; how many steps would a man have to make, in going the whole distance, who made 2½ feet at each step?

58. How many iron rails, of 15 feet long, would it take to make a *double* line for steam carriages the whole length of the Great Western Railway, which is 162¾ miles in length?

59. Supposing the circumference of a steam carriage wheel to be 6½ feet, how many revolutions or turns will be made by the wheels of 6 carriages from London to Birmingham, a distance of 112½ miles, each carriage having four wheels of equal dimensions?

60. How many barley-corns would reach round the earth, reckoning the circumference 360 degrees, each degree 69½ miles?

61. The land measurer's chain, called Gunter's chain, contains 100 links, and measures 22 yards in length; how many inches is it in length, and what is the length of each link?

SQUARE MEASURE.

62. In 482 acres, 3 roods, 17 poles, how many perches?

63. Reduce 4,109,640 poles to acres.

64. A room measures 23 feet long and 18 feet wide, how many square feet are contained in it, and how much carpet, a yard wide, will cover it?

65. A gentleman having purchased a new house, employs a paper-hanger to cover the drawing-room, but being dissatisfied with the charge, employs a person to measure the walls, when he finds the paper-hanger has charged him for 10 yards more than there were in measurement; the dimensions were as follow: the two ends measured 10 feet 6 inches high, by 16 feet 3 inches, and the two sides were 10 feet 6 inches by 24 feet; what was the actual measurement, and what quantity did the paper-hanger charge for, no allowance being made for windows, &c.?

66. A person having a court yard to pave with stones exactly a foot square; what number will he require if the yard measures 47 feet long and 24 feet wide?

67. A person having a piece of ground situated on a beautiful eminence near Norwood, containing 4 acres 3 roods 20 poles, wishes to build a mansion and stables; for the house and stables he intends to allot 2 roods 15 poles; for the kitchen garden and pleasure grounds, 1 acre 2 roods 10 poles; and the rest he wishes to convert into 2 pastures for his horses, and to make them equal in size; what must be the content of each pasture?

CUBIC MEASURE.

68. How many cubic inches are there in a block of granite which is 16 feet long, 4½ feet wide, and 2 feet in thickness?

69. In 618,347,218 cubic inches, how many solid yards?

70. How many solid inches are contained in 100 loads of square timber?

WINE AND BEER MEASURE.

71. In 496 hogsheads 52 gallons 2 quarts, how many pints?

72. How many gallons, quarts, and pints are contained in a pipe of port wine?

73. Reduce 120 hogsheads of brandy to ankers.

74. Reduce 472,500 gallons to tuns.

75. A merchant has a pipe of Lisbon which he wishes to draw off into bottles containing pints, quarts, and 2 quarts, and to have an equal number of each; how many should he have?

76. In 594 barrels of ale, how many pints?

77. In 72 hogsheads of ale, how many barrels?

78. If a cask holds 120 barrels, how many gallons does it contain?

79. In 4 tuns of oil, how many hogsheads, gallons, and quarts?

80. In 258 butts of porter, how many pints?

81. How many firkins are there in 50 butts of beer?

DRY MEASURE.

82. In 72 quarters of wheat, how many pecks?

83. How many pecks of 14 lbs. each, are contained in a sack of flour?

84. How many sacks are there in 45 tons of coals?

85. How many bushels of apples are there in 25 sacks?

86. In 197 lasts of corn, how many pints?

TIME MEASURE.

87. In 365 days, 5 hours, 48 minutes, and 45½ seconds, which is a *solar* year, how many seconds?

88. How many seconds are contained in 354 days, 8 hours, 48 minutes, 33 seconds, a *lunar* year?

89. Reduce 17 years, 10 months, 2 weeks, 6 days, 19 hours, to seconds.

90. How many minutes have elapsed since the foundation of Rome, which happened 753 years before Christ?

Examples for Exercise.

91. In 1695 there were 572 bags, each containing 100*l.* carried to the mint; these bags contained coins of various amounts in value, and *ought to* have weighed 18,451 pounds, 6 ounces, 16 dwts., 8 grains Troy; but through clipping

and filing they had become so reduced as to weigh but 9,480 pounds, 11 ounces, 5 dwts.; what was the deficiency of the weight, and how many pieces of money could be made out of it of the following value and weight:—1 crown, weight 19 dwts. $8\frac{16}{31}$ grains; a half-crown, weight 9 dwts. $16\frac{8}{31}$ grains; a shilling, 3 dwts. 20 $\frac{28}{31}$ grains; a sixpence, 1 dwt. $22\frac{14}{31}$ grains; and an equal number of each?

92. In the reign of Queen Elizabeth the amount of silver money coined was 4,632,932*l.*; by James I., 1,700,000*l.*; and by Charles I., 8,776,544*l.*; how far would this extend in length supposing the whole amount to be in shillings, and each shilling to be seven-eighths of an inch in diameter.

93. There are 30,000,000 acres of land in Great Britain and Ireland cultivated by the plough, two-fifths of which are annually sown with wheat, two-fifths with barley, and the remainder with oats; what quantity of each sort of grain will it take to sow the land for crops, allowing $3\frac{1}{2}$ bushels to each per acre?

94. For the whole annual supply of gas to the metropolis there are required 200,000 tons of coals, which produce 2,400,000,000 cubic feet of gas, weighing 75,000,000 pounds. The light produced by these means is equal to 160,000,000 pounds of mould candles of 6 to the pound; the bulk of coal is equal to 400,000 cubic yards: what is the value of the coal at 25*s.* per ton? how

long would the gas last at 5 cubic feet per hour for each burner, reckoning 168,000 burners, burning on an average 6 hours per day? what is the number of cwts. contained in the whole? and what would it cost for mould candles during the same period of time, supposing they were used as a substitute for the gas, reckoning them at 7½*d.* per lb.?

95. The Thames Tunnel was opened March 25, 1843, after 20 years' labour under the direction of Sir Isambert Brunel, chief engineer, at a cost of about 1,000,000*l.*; how many passengers must pass through it to realize that, at one penny each? and how long, supposing that 300 pass through it every day?

96. The bullion in the Bank of England, in March, 1843, amounted to about 12,000,000*l.*, supposing it to be in solid bars of gold; what would it weigh if coined into sovereigns, each sovereign weighing 5 dwts. $3\frac{171}{623}$ grains?

97. The quantity of hard soap subject to the Excise duty in 1840, amounted to 159,220,098 pounds; what has Government to receive at 1½*d.* per pound?

98. The quantity of silver used in the manufacturing of watches in England is 506,000 ounces; how many cases of 2½ ounces each can be made from the above quantity?

99. A hawk was taken at the Cape of Good Hope in September, 1792, with a golden collar about its neck, on which was the following in-

scription:—"This goodlie hawke doth belong to his most excellente Majestie James King of Englande, A.D. 1610;" how many days and years elapsed between these two periods?

100. The Emperor of Russia has a diamond which was once the eye of an idol in the East Indies, and was stolen by a French soldier who deserted his regiment, and contrived to become a priest. He afterwards sold it to a sea captain for 20,000 rupees, or 2000*l.*; a Jew then bought it for 17,000 guineas, and sold it for 20,000*l.* to a Greek merchant, who sold it at Amsterdam, to Prince Orloff, through whom it came to the Empress Catherine, who had it placed in her sceptre. It cost 136,000*l.*, and weighed 779 carats, each $3\frac{1}{6}$ grains, Troy; what did each person gain by his bargain, and what was the weight of the diamond in ounces Troy?

101. The Chinese ransom to be paid to her Majesty Queen Victoria's Government, on account of the hostilities and cruelties to some of the English in the Chinese territories in 1842, amounted to 21 millions dollars; how many pounds sterling in British money, reckoning a dollar to be 4*s.* 6*d.*?

102. A gentleman who resided in a country village, distributed amongst the poor 25*l.* 10*s.* according to their ages: to those who had attained 80 years he gave 5*s.* each; to those at 70, he gave 3*s.* each; to those at 60 years, 2*s.* 6*d.* each; and *to four poor widows*, who were blind, he gave 7*s.*

each; how many persons were relieved by his bounty, and what sum remained?

103. In 1537 we find among the expenses of the Princess Mary, daughter of Henry VIII., and afterwards Queen of England, that she bought of the Mayoress of London, Lady Gresham, six bonnets at 1*l.* each, for new year's gifts, and paid for two frontlets 10[illegible]; and at the christening of King Edward VI., she gave to the Queen's nurse 40*l.*, and 40*s.* in alms to the poor on the day of his birth; how many nobles and marks, and of each an equal number, were contained in these amounts?

CONVERSATION XX.

ON SIMPLE PROPORTION.

CONSTANTIA.

OUR next step, Lavinia, is to say a little about the rule called Proportion.

LAVINIA.

I think I shall now begin to feel more interest than ever in the science of numbers, since you are so kind in removing all difficulties out of the way.

Is there no other name given to this rule?

CONSTANTIA.

Yes; it is frequently called the Rule of Three, because *three* terms are given to find a *fourth;* but Proportion is the more correct term.

LAVINIA.

This reminds me of my cousin Richard, whom I have often heard sing:—

"Multiplication is vexation,
Division is twice as bad;
The Rule of Three does puzzle me,
And Practice drives me mad."

CONSTANTIA.

Never mind being puzzled, Lavinia, if you can afterwards understand it.

Proportion consists of three kinds:—

First, Simple or Direct Proportion.
Second, Inverse Proportion.
Third, Compound Proportion.

These are sometimes treated of promiscuously under the term proportion; but in order to give you a clear perception of them, I shall explain each rule separately.

First, then, let me explain to you the meaning of the word PROPORTION as it is applied in arithmetic, that you may clearly understand what is meant by the term.

Proportion is the relation which one thing bears to another of the same kind, and it may be equal, greater, or less, according to circumstances; your age may be the same as Caroline Wilson's, but she may be taller than you are, she is therefore taller than you are in *proportion* to your age; you may purchase a yard of ribbon in Saint Paul's Churchyard, and I may purchase a yard in Camberwell of the same quality and pattern, yet mine may be much dearer than yours. One person may purchase a hundred-weight of sugar for 6*d.* per pound, which would amount to 2*l.* 16*s.*; but another person who might purchase a less quantity of the same quality would be charged 6½*d.* per pound, which would be 3*l.* 0*s.* 8*d.* per cwt., this would make a difference of 4*s.* 8*d.* per cwt., and it would of course be dearer in proportion by the *pound* than by the *hundred-weight.* It is the same, by walking or riding any distance; you may travel 40 miles on the Birmingham Railway in an hour and a half; while another person may be two hours travelling the same distance on the Great Western Railway, therefore the rate of speed would be faster on the Birmingham Railway than on the Great Western.

In common conversation, you frequently say, this is greater than that; this is further than that; this is heavier than that, and so on; therefore the more knowledge you have of this rule the more correctly will you be able to speak and judge of many things in general conversation, and be able in many instances to determine what is the exact proportion which one thing bears to another.

LAVINIA.

It appears, then, that more than *one* thing is required to form a *proportion?*

CONSTANTIA.

Just so; there must be something *known,* for you cannot form an idea of proportion without it.

LAVINIA.

That, I think, I understand.

CONSTANTIA.

Let us now come more particularly to the rule Proportion as it is applied to the working of questions.

1. The given question always consists of *three* terms, two *answered* terms, and one term *not answered.*

In stating the question, which is placing the three terms in their proper order, for the sake of simplicity, always put the *unanswered* term in the *third* place.

2. Let your *first* term be of the same nature or quality as the *third;* that is, if *money* be the first term, the third must be the same; if it consist of weight, measure, or distance, the third term must be the same.

3. Let your *second* or middle term be of the same nature or quality as that in which the *answer* is required; that is, if the answer be required in money, weight, or measure, the middle term must be the same; proceed thus with every question. This is the first part of the rule, which I trust you will see more clearly when I show you how to work an example.

LAVINIA.

I am greatly obliged for your kind attention, I shall endeavour to perform all you wish me, and I wait with pleasure to hear you explain the *remaining* part of the rule.

CONSTANTIA.

4. The next thing, after stating the question, is to observe whether any of the terms require to be reduced by the rule Reduction, for if your *first* term consists of pounds, shillings, and pence, and your *third* term of *pounds* only, they must both be reduced to the same denomination, before you can proceed to the next step.

5. Having done this, reduce the *middle* term to the lowest name of which it consists; that is, if it be pounds and shillings, you must reduce it to shillings, and so on, if the denominations are lower.

6. When you have thus prepared all the terms in the stating, multiply the *second* and *third* terms together, and divide that product by the *first*, the quotient will be the answer in the same name that you left your middle term in *before* dividing it; if in pounds, the quotient will be pounds; if in shillings, pence, or farthings, the answer will be accordingly.

LAVINIA.

I think, after the trouble you have taken to explain this rule to me, Constantia, that I cannot fail to understand its application. I had always a dread of it from what my brothers had said; for Mr. Pemberton was always very cross because they could not understand it, though he never had *patience to explain* it in language suitable to their understandings. Now I shall have a good laugh at the boys when they return home at Midsummer; and I shall also tell Edward not to be so vain as to imagine that a knowledge of arithmetic is confined entirely to the boys of Mr. Pemberton's school, or to those at King's College.

CONSTANTIA.

Well, my dear girl, there is no harm in a joke upon your brothers, seeing that they think your sex are incapable of obtaining a knowledge of figures. I should like you to read this rule over until you learn it thoroughly, for it is of so much importance that you will find it the key to almost every difficulty in arithmetic. I shall not proceed any farther till to-morrow; you will then have done what I wish, and I shall proceed to explain to you some examples.—Adieu.

CONVERSATION XXI.

ON SIMPLE PROPORTION—CONTINUED.

CONSTANTIA.

GOOD morning, Lavinia, I suppose you have come prepared to be very industrious; well, industry must be your motto still, and you will be sure to succeed. I shall now give you some examples, and explain their meaning.

Examples.

1. If 4 yards of lace cost 6*s.*, how much will 12 yards cost at the same rate?

Stated thus:

$$\begin{array}{lcccc} \text{yards} & & s. & & \text{yards} \\ \text{As } 4 & : & 6 & :: & 12 \\ & & 12 & & \\ \hline & 4\,) & 72 & & \\ \hline \text{Answer} & & 18 & \text{shillings.} & \end{array}$$

In this simple example you may see how I apply the rule; you may also observe that in this question *two things* are *answered*, and one un-

answered. It clearly states that 4 yards may be bought for 6*s.*, and that 6*s.* will buy 4 yards, these are therefore the two *answered* terms; but it does not state what 12 yards will cost; you are to discover this by the rules laid down, and always take care to let the *unanswered* term be the *last.*

The *first* and *third* terms are here alike, both being yards; the *middle* term consists of money, because the *answer* is required in money; after the second and third terms are multiplied together, and that product divided by the first term, the answer is 18 shillings, which is of the same name as that in which you left your *middle* term.

I will now change the form of this example, and use the same terms.

2. If 12 yards of lace cost 18*s.*, what will 4 yards cost at the same rate?

Stated thus:

```
  yards          s.            yards
As 12    :       18      ::      4
                  4
                 ——
           12 ) 72
                 ——
        Answer    6   shillings.
                 ——
```

Here you see, 4 yards is the unanswered term in the question, and it is put in the *third* place; and we find 4 yards cost 6*s.*, as was stated in the first example. By this plan you may prove any sum in the Rule of Three; but when there is a *remainder* it is difficult for a learner to do that.

LAVINIA.

This appears very clear; but I suppose I shall not find them all so easy to understand.

CONSTANTIA.

I think with care and attention you may. There is another form in which this example may be placed, and equally correct: that is, by dividing the first two terms in the stating by any number that will do it without a remainder, and use the quotients of these numbers.

Thus:

```
      yards          s.               yards
   6 ) 12        6 ) 18
       ——            ——
  As    2    :        3     : :        4
                      4
                     ——
                 2 ) 12
                     ——
           Answer     6  shillings, as before.
                     ——
```

Here, though you change the figures, you do not alter the *proportion*, for 2 bears the same proportion to 3, as 12 does to 18, being just two-thirds of it.

Example.

3. If 6 yards of velvet cost 1*l.* 17*s.* 6*d.*, how many *yards can I* buy for 18*l.* 10s.?

Stated thus:

```
         £  s.  d.     yards.       £   s.
As       1  17  6   :    6    ::    18  10
        20                          20
        ——                         ———
        37                         370
        12                          12
       ———                         ———
       450                         4440 yards
       ———                            6
                                  ————
                           45,0)2664,0(59⅕ Answer.
                                 225
                                 ———
                                 ·414
                                  405
                                 ———
                                  ··9
                                 ———  = ⅕
                                  45
```

In this example you must observe, that your rules for reduction are to be applied, because your first and third are not in the same denomination, therefore you make them so by reduction, and proceed as before, and the quotient is 59 yards, and 9 remaining, which is $\frac{9}{45}$ths of a yard, and that equals $\frac{1}{5}$, the answer is therefore 59$\frac{1}{5}$ yards.

LAVINIA.

But I observe you cut off a cipher in the divisor and dividend.

CONSTANTIA.

This may always be done where there is an equal number in each, as I remarked in Division; I will give you another example where *all* the *terms* require to be reduced.

Example.

4. If 4 lbs. 8 ozs. 13 drs. of tea cost 1*l.* 5*s.* 9*d.*, how much will 7 lbs. 6 ozs. cost at the same rate?

Stated thus:

```
   lbs. ozs. drs.        £    s.   d.        lbs. ozs.
As  4    8   13    :     1    5    9    ::     7    6
   16                   20                    16
   —                    —                    ———
   72                   25                   118
   16                   12                    16
  ———                  ———                   ———
  445                  309                   708
   72                  ———                   118
  ———                                        ———
 1165                                       1888
 ————                                        309
                                           ————
                                           16992
                                           5664
                                           ————
                                     1165)583392(12 )500
                                           5825      ———
                                           ———— 20)  41–8
                                           ...892    ————
                                              4
                                           ————      2–1–8
                                     1165) 3568(¾    ————
                                            3495
                                            ————
                                             ··73
```

Answer £2. 1*s.* 8¾*d.*—73 remainder

Here the quotient, after the division, consists of pence, which I reduce to pounds. I think, Lavinia, these examples are sufficient to show you clearly the meaning of the rule, and when you have made yourself tolerably acquainted with it, I will explain to you the difference between DIRECT *and* INVERSE Proportion.

LAVINIA.

You are very patient and kind to explain away so many difficulties.

CONSTANTIA.

You will find this rule so extremely valuable in almost all calculations, that you will never regret the trouble you take in learning it; it is frequently called the Golden Rule, from its value in solving so many questions. You will find it very useful when you study the use of the globes, where it is used to illustrate many interesting questions.

The following examples I trust, with a little assistance, you will be able to understand: —

Examples.

5. If 1 lb. of cheese cost 9½*d.*, what will 1 cwt. cost?

6. If 1 cwt. of coffee cost 9*l.* 18*s.* 6*d.*, what is that for 1 lb.?

7. What will 4 dozen of mould candles cost, if 1 lb. cost 1*s.* 3½*d.*?

8. Bought a firkin of butter for 2*l.* 19*s.* 6*d.*; what cost 1 lb.?

9. Bought a packet of Hyson tea containing 6 lb., at the rate of 6*s.* 9*d.* per lb.; what did the whole packet cost?

10. What will a shiver of beef cost weighing 27½ lbs. at 7½*d.* per lb.?

11. Bought 10 tons of the best Wallsend coals at 28*s.* per ton; what was that per sack?

12. Gave 1*l.* 10*s.* for 69½ yards of calico; at what rate did I buy it per yard?

13. I bought 4 pairs of white cotton stockings for 7*s.* 6*d.*; what is that per dozen?

14. Bought 5 pieces of quilling net, each containing 47½ yards, at 2⅝*d.* per yard; what did the 5 pieces cost me?

15. Bought 97½ yards of Brussels carpeting at 3*s.* 9*d.* per yard; what did the piece cost?

16. Gave 13*l.* 10*s.* for 5 pieces of Holland, each 12 ells English; what is that per yard?

17. A servant disagrees with her Mistress after she has lived with her 4 months, 3 weeks, 4 days; she was hired at 12*l.* 10*s.* per annum; what money had she to receive?

18. If an ounce of silver be worth 5*s.* 6*d.*, what is a tankard worth that weighs 2 lbs. 11 ounces 12 dwts. 15 grs.?

19. If a person lays by 2*s.* 6*d.* per week, how long will he be in saving 100*l.*?

20. A person failing in business, calls together his creditors, and gives them his stock, book debts, and cash, to be distributed amongst them, which amounts to 495*l.* 18*s.* 6*d.*, and his debts to 942*l.* 11*s.* 8*d.*; what will each creditor receive in the pound, and how much will they lose by the failure?

21. A person hearing that a tradesman had failed who was indebted to him 279*l.* 16*s.* 4*d.*, was willing to receive 10*s.* 9*d.* in the pound; how

much would his dividend amount to, and how much would he lose of his debt?

22. The father of a young lady 14 years of age, presented her with 50*l.* which she placed out to interest at 5*l.* per cent. per annum; what sum would she have coming to her at the age of 21 years?

23. A gentleman's house and premises are assessed to the poor-rate 342*l.* 10*s.*; the assessment on the whole parish is 1098*l.* 19*s.* 6*d.*, and a rate is made for the relief of the poor amounting to 89*l.* 15*s.* 6*d.*; what sum must this gentleman pay towards the amount?

24. If a person spends 7*s.* 6*d.* a day, what will it amount to in a year of 365 days?

25. A gentleman possessed of an income of 300 guineas a year, is desirous of laying by 50*l.* per annum in case of sickness; what ought his weekly outgoings be to do this?

26. A gentleman bought an estate consisting of 72 acres 3 rds. 19 pls., and gave at the rate of 52*l.* 10*s.* per acre; for the valuation he paid 429*l.* 16*s.* 6*d.*; and to furnish his house 725*l.* 16*s.*; what was the whole amount of cost after he had paid these sums?

27. A family consisting of 12 persons consumes as much meat as amounts to 4*l.* 10*s.* weekly; supposing the same number every day, what would the yearly amount be, and how many pounds would be purchased, reckoning the meat on an average at 7½*d.* per lb.?

28. A person wishes to purchase floor cloth for a hall that measures 12 yards long, and 2½ yards wide, and he agrees to give 2*s.* 8*d.* per *square* yard; how many yards will it take to cover the hall, and what will it cost?

29. I bought a piece of Welsh flannel containing 49¾ yards, and gave at the rate of 5*s.* 3*d.* for 3 yards; what did the flannel cost me?

30. How long will a person be saving a thousand pounds in business if his clear profits amount to 75*l.* 18*s.* a year?

31. The best Stilton cheese is about 1*s.* 3*d.* per pound; if I buy 7 cheeses at that price, weighing on an average 10¾ lbs. each, what will they cost me?

32. What will 1 cwt. of rice cost, at 5*d.* per pound?

33. If a sack of potatoes weighing 168 lbs. cost 8*s.* 6*d.*, what will 4 tons cost at that rate?

34. What will 9 quarters of oats come to at 3*s.* 6*d.* a bushel?

35. If a family of 9 persons consume a firkin of beer in 7 days, how long ought a barrel to last the same number of persons?

36. I bought 4 pieces of book muslin, each 12 yards, and gave 6*l.* 18*s.* 6*d.* for them; what did the muslin cost me per yard?

37. How many dresses could be made out of a piece of Gros de Naples measuring 72 yards, allowing 15½ yards to each dress; and what would

be the price of the silk, and of each dress, supposing it cost 4*s.* 3*d.* per yard?

38. By the income-tax law, every person whose income is 150*l.* per annum, and above that amount, has to pay a tax of 7*d.* for every pound; what is that per cent.? and how much is the income of a person who pays towards it annually the sum of 80 guineas?

39. How many pairs of Witney blankets can I buy for 20 guineas, at 1*l.* 18*s.* 6*d.* a pair?

40. Bought of a tradesman $2\frac{1}{2}$ cwt. of sugar at the rate of $9\frac{1}{2}$*d.* per lb., but on payment of cash he agreed to allow me 5*l.* per cent. on the amount; what was the deduction made? and what sum had I to pay him?

41. Bought $3\frac{3}{4}$ lbs. of tea for 1*l.* 5*s.* 6*d.*; how much would 9 lb. $10\frac{1}{2}$ ozs. cost me at the same rate?

42. What will a fother of lead come to at 25*s.* 6*d.* per cwt.?

43. A man agrees to perform a piece of work for 4*l.* 16*s.*, and finishes it at the end of 3 weeks 5 days; how much were his daily earnings?

Examples for Exercise.

44. From a pound of standard gold they coin at the Mint $46\frac{29}{40}$ sovereigns, each weighing 5 dwts. 3 grs.; what quantity of gold must be had to coin 1000 sovereigns?

45. A person bought 5 chests of tea, each con-

taining 84 lbs., at 3*s.* 4½*d.* per lb., and he wished to gain 10 guineas by the bargain; what must he sell his tea at per lb.?

46. A person bought a quantity of linens amounting to 189½ yards for 20 guineas, but in consequence of their being damaged he sold them out at 1*s.* 10½*d.*; what did he gain or lose by the transaction?

47. Three persons, A, B, and C, who were friends, appointed one fine morning to walk to a neighbouring seaport town to see a ship launched, and to dine with their relatives, but as they lived each a different distance from the town, they agreed to start accordingly, in order to reach the place at the same time. A's distance was 9 miles; B's 10½; and C's 12 miles; A starts at half-past seven in the morning; B at seven; and C at half-past six, and they all arrive at the end of their journey at a quarter before eleven; at what rate per hour did each of them travel?

48. A hare pursued by a greyhound was 75 yards before him at the time of starting; whilst the hare ran 7 yards the dog ran 10 yards; how far would the dog run before he caught the hare?

49. The hour and minute hands of a clock are together between the hours of three and four; what is the *exact* time of the day, and when will they be together a second time?

50. The earth under the equinoctial line is 360 degrees in circumference, each $69\frac{1}{10}$ miles: if this *body revolves on its* axis in 24 hours, at what rate

per hour are the inhabitants of the equator carried from West to East?

51. A person bought a quantity of wine for 100 guineas at 12*s.* 7*d.* a gallon, but on taking it home the cask was staved and some of the wine was lost; after selling the remainder for 13*s.* 6*d.* a gallon, his returns were only 90 guineas; what quantity of the wine was lost?

52. A tradesman bought 5 tuns of oil for 287*l.* 16*s.*, but one of the casks got damaged so as to lose 50 gallons; he is desirous of knowing how to sell it per gallon so as not to lose by the bargain?

53. A gentleman living in India had acquired a fortune of 20,000*l.*, which he consigned to his agent in London, except 1000*l.* which he reserved to himself for his voyage to England, and to discharge his debts in India before leaving; these debts amounted to 289*l.* 17*s.* 6*d.*, the remainder he took with him on board; but he was shipwrecked near the island of Ceylon, where he lost all that he had but a 100*l.* bank of England note which floated upon the water near the plank on which he reached the shore; out of this he paid 60 guineas for his passage home by another vessel, and when he reached England his agent had failed in business and offered his creditors 5*s.* 9*d.* in the pound; what had he to receive after all these misfortunes?

54. Mr. Green's large Nassau balloon measured 150 feet in circumference, and 80 feet in height,

and was covered with 2,000 yards of silk which cost 700*l.*: it contained 70,000 feet of gas at 18*s.* for 1000 feet; what was the cost per yard of the silk, and what did the expense of the gas amount to?

54. The pressure of weight against the shield used in constructing the Thames Tunnel, is said to amount to 3,000 tons over a superficies of 2,000 square feet; what is the pressure upon a square inch at the same rate?

55. The earth moves in its orbit round the sun at the rate of 68,000 miles per hour, and performs an entire revolution in a sidereal year or 365 days 6 hours 9 minutes 14½ seconds; what is the distance in miles which it travels to make an entire circuit of the sun?

56. In Paris there are 250 houses exclusively engaged in the manufacture of bronze of various descriptions, in which are made 15,000 clocks worth 10*l.* each; 40,000 pairs of candlesticks at 16*s.*; 3,000 pairs of candelabra at 8*l.*; 100 *surtouts de table*[*] at 60*l.*; 60,000 glass covers at 8*s.*; chandeliers and lamps, 40,000*l.*; small articles, 72,000*l.*; articles of luxury, 80,000*l.*; what amount does this branch of manufacture produce annually in Paris alone? and what amount of wages are paid annually to the men at 5*s.* a-day, the number being 6,000?

---

[*] "Surtouts de Table" are large ornamental vases for holding flowers, which are placed in the centre of the table at dinner *parties.*

57. The magnificent gates of the central opening of the triumphal arch in front of Buckingham Palace, were designed and cast by Mr. Samuel Parker, of Argyle Place, London, and are considered the most superb in Europe. They are made of a beautiful alloy, the base of which is refined copper, and are of a gold colour; the height of each gate is 21 feet, and the width 7 feet 6 inches. The weight of each gate is 2 tons 13 cwt., and their thickness 3 inches, yet they are so hung that a child may open or shut them; and the weight of the frieze and arch 1 ton 9 cwt. 1 qr. The total cost was 3,000 guineas, how much was that per pound?

58. In Hanson's Patent Steam Carriage, which carried passengers, in 1834, from the City to Islington, the consumption of coke was about 12 lbs. per mile, and 100 lbs. of water; how far would 20 tons of coal carry them at the same rate, and how many cubic feet of water would be required, if a cubic foot weighs 997$\frac{1}{10}$ ounces avoirdupois, to carry them as far as their supply of coals?

59. The construction of the human frame is one of the most sublime works of the Creator. The heart contracts about 4,000 times every hour, and ejects one ounce every time; and the body contains about 25 lbs. of blood; how many times its own weight of blood passes through the heart in 24 hours, allowing the contractions to be uniform?

60. The air presses upon the body of a human being 18 lbs. $7\frac{5}{9}$ ozs. to every square inch in a fine day, and the superficies of a man's body is about 15 square feet; how many tons weight does he support? and what is the difference of weight which he sustains between a fine and a gloomy day, when on the latter the pressure of air is 3,902 lbs. to the square foot?

61. It is stated that there are 168,000 gas burners in London alone, and that each burner consumes on an average 5 cubic feet per hour; what would be the annual charge for lighting the metropolis, reckoning the average time of burning 5 hours each, and the charge to be 9*s.* for every 1,000 feet?

62. If a staff of 3 feet in height, cast a shadow 4 feet 9 inches long; what length of shadow will be cast by the great Pyramids of Egypt, at the same hour of the day, if the height be 500 feet?

63. The number of British vessels shipwrecked annually is about 780, and the average burden of tonnage for each ship is 110 tons, reckoning each vessel at half the cost of building, which is 5*l.* 10*s.* per ton; what is the whole loss annually?

64. What quantity of coals must be carried in a steam vessel of 300 horse power, on a voyage of 9 months, reckoning 15 lbs. of coal per hour to every horse power?

65. In the construction of a watch, the number of pieces, and trades employed, are as under:—

No. of parts.		No. of pieces.	No. of trades.
1	Pillars	4	1
2	Frame	4	1
3	Cock and Potence	2	1
4	Barrel and Arbor	3	1
5	Going-Fusee	14	2
6	Wheels	4	1
7	Pinions	4	2
8	Stop-stud	1	1
9	Stop and Spring	3	1
10	Click and Ratchet	3	1
11	Motion	16	2
12	Jewels (5 holes)	28	2
13	Cap	3	2
14	Dial	5	3
15	Index	1	1
16	Escapement	13	3
17	Compensation-balance	9	1
18	Case	3	1
19	Pendant	2	1
20	Case-joint	6	1
21	Case-spring, &c.	4	2
22	Main-spring	1	2
23	Chain	826	3
24	Hands	3	1
25	Glass	1	1
	Total of pieces	963	
	Engine Turner		1
	Engraver		1
	Gilder		1
	Examiner		1
	Total Number of Artificers employed		42

There are 240,000 silver cases stamped annually at the Assay Offices in England; supposing the same number of watches to be manufactured, and the same number of men to each watch, how many men would it give employment to, supposing every 42 men completed 100 watches in a year; and what would their wages amount to at *2 guineas* per week on an average?

66. In building and repairing ships, docks, &c., belonging to His Majesty's naval service, from 1823 to 1833, there were used 1,216,719 loads of timber, which cost 6*l.* a load; how much did the timber amount to? and how many vessels of the rates given below could be made out of the timber, supposing a *first-rate* ship consumes in her construction 5,880 loads; a *second-rate,* 4,839; a *third-rate,* 3,600 loads; a *fourth-rate,* 2,732; a *fifth-rate,* 1,800 loads; and a *sixth-rate,* 963 loads; having an equal number of vessels of each rate?

67. Some idle boys once amused themselves by pumping the parish well dry, which belonged to the poor, and in order to do it as quickly as possible, when one left off, another began; they pumped 100 strokes every quarter of an hour, and drew 2 gallons from the well every 4 strokes; after pumping for 2¾ hours, they found the well without water; how many strokes were performed by these idle boys? and what quantity of water did they throw away?

CONVERSATION XXII.

ON INVERSE PROPORTION.

CONSTANTIA.

THERE is no material difference between the working of this Rule and the last, except that after you have reduced your terms to their proper denominations, you multiply the *first* and *second* terms together for a dividend, and make your *third* term the divisor; the result will be the answer, in the same denomination as that in which you left the second term.

Example.

1. If 3 men can mow a meadow of grass in 4 days, how many men can do it in 3 days?

	Days.		Men.		Days.
As	4	:	3	::	3
			4		
			3)12		
Answer......			4 men.		

You may observe from the nature of the question, that the answer is required in men: there*fore* as in the last rule, men must be the middle *term,* and because it is Inverse Proportion, you multiply the *first* and *second* term together, and divide by the *third.*

LAVINIA.

But I do not yet see the difference between Direct and Inverse Proportion.

CONSTANTIA.

Well, my dear, I will explain it to you by two examples, as it is but little understood by beginners.

Direct proportion is when *more* requires *more,* and *less* requires *less.*

Inverse Proportion is when *more* requires *less,* or *less* requires *more.*

Example of Direct Proportion.

2. If in one day 3 men can reap 2 acres of wheat, how many acres can 6 men reap in the same time?

Stated thus

	Men.		Acres.		Men.
As	3	:	2	::	6
			6		
			3)12		
Answer......			4 acres.		

Now it must be clear to you, Lavinia, that

6 men can reap more than 3 men in the same time; and the answer will be *greater* than the second term; consequently *more men* will reap *more wheat* in the same time; it is therefore an example of *more* requiring *more,* and the Proportion is *direct.* If your third term had been less than the first, it would have been *less,* requiring *less.*

Example of Inverse Proportion

3. If 2 men can reap a field of wheat in 3 days, how long will it take 6 men to reap the same?

Stated thus:

	Men.		Days.		Men.
As	2	:	3	::	6
			2		
		6)	6		
		Answer......	1 day		

Here it is equally evident that 6 men will not be so long in reaping the same field as 2 men, therefore the answer is *less* than the *middle* term, for it is *more men* requiring *less* time; or *more* requiring *less;* therefore the Proportion is *Inverse.* You are, then, always to bear in mind, in this part of arithmetic, that,

When *more* requires *more,* or *less* requires *less, the proportion* is DIRECT.

BUT,

When *more* requires *less*, or *less* requires *more*, the proportion is INVERSE.

LAVINIA.

I see; in Inverse Proportion there is an opposition of meaning in words *more* and *less;* but in Direct they are not so, because it is *more* and *more*, or *less* and *less*.

CONSTANTIA.

That is quite correct, Lavinia.

LAVINIA.

Well, after a little practice, I think I shall master all these difficulties; I am not at all discouraged while I have you for my instructress, and I think difficulties must give way to perseverance.

CONSTANTIA.

That is my decided opinion, and I shall leave you to work at your convenience the following examples:

Examples.

4. If 6 horses eat 23 bushels of oats in 9 days, how long will the same quantity last 14 horses

5. Lent a friend 140*l.* for 12 months, with a promise that he would lend me 100*l.* in return; how long ought I to have it to requite my kindness to him?

6. A gentleman began to make hay one fine morning in June, and he hired 8 men to mow his grass, and they were to have mowed it in 6 days; but unfortunately two of the men were taken ill; in what time would the rest finish it?

7. A traveller performs a journey in 4 days, when the day is 16 hours long; how many days will be required to go the same journey when the day is 12 hours long?

8. How much in length, that is 3 inches wide, will make a square foot?

9. How many pounds of sugar at 8½*d.* per lb., are worth 16 lb. of tea at 5*s.* 4*d.* per lb.?

10. A building was raised in 14 months by 72 workmen; but through an error in the construction, it gave way and fell, and was to be rebuilt in 3 months, how many men must be employed to complete the work?

11. If when the price of flour is 2*s.* 6*d.* per peck, the penny loaf weighs 5 ozs., what should it weigh when flour is sold for 3*s.* per peck?

12. The statute acre, if 40 poles long, is 4 poles wide, what length must it be if the width be 12 poles?

13. How many yards of paper 27 inches wide, will cover a room that is 24 yards in circuit, and 10 feet 3 inches high?

14. How many yards of matting, half a yard wide, will cover a floor that is 18 feet wide and 30 feet long?

15. There were placed in a garrison 800 men, with provisions for 2 months; how many men must depart, that their provision may last 5 months?

16. The general of a besieged place having provision for 54 days, at the rate of 1½ lb. for each man; but he is desirous to prolong the siege to 80 days in expectation of succour; what must each ration be to hold out this time?

17. If 65 yards of carpet, 1 yard wide, be sufficient to cover a room, how many yards of Brussels will it take of 3 qrs. wide?

18. How many yards of stuff, 3 qrs. wide, will line a cloak 1¾ long, and 3½ yards wide?

19. If I pay 17*s.* 6*d.* for the carriage of a ton weight by railway for 52 miles, what weight ought I to have carried 100 miles for the same charge?

20. If 20 sheep eat an acre of turnips in 6 weeks, how many will eat the same in 3 weeks?

21. If 30*s.* worth of wine will be sufficient for 46 men, when the tun is worth £24., how many men will the same suffice, when the tun is worth £16.?

CONVERSATION XXIII.

ON COMPOUND PROPORTION.

LAVINIA.

WELL, Constantia, as I have finished all you gave me to do in the last Rule, I suppose we shall proceed now to Compound Proportion.

CONSTANTIA.

That is our next step, my dear girl; I shall therefore hasten to explain the meaning of the term.

Compound Proportion is that part of the rule which is applied to questions which, in Simple Proportion, would require two or more statings; but by the rule which I shall give you, you may resolve any question, how many statings soever there may be, whether Direct or Inverse. I give you this rule because it is simple, and will answer *all questions* in common proportion. There are other rules which separate *causes* from *effects,* &c., but it is so frequently a great difficulty for a young beginner to know these *causes* from the *effects,* that I shall give you no rule of the kind.

RULE I.—As in the rule of Direct Proportion, place down for the *middle* term, the given term, that is of the same nature as the *answer.*

II.—Place the *known* terms, or terms of *supposition* on the *left* hand; these terms may be known by depending upon the word *if.*

III.—All the other terms must stand on the *right* hand, and are the terms of *demand* or *unanswered* terms; taking care to let every *first* and *third* term be of the same name.

IV.—Reduce the *first* and *third* terms to the same denomination, and the *middle* one to the lowest name mentioned.

V.—Now, if by the nature of the question *more* than the middle term be required, mark the *less* of the two *outer* terms with a cross for a divisor; but if *less* than the middle term be required, mark the *greater* of the two *outer* terms for a divisor in every stating. Multiply all the terms together that are marked for a *divisor;* and all the others for a *dividend;* the quotient of this work will be the answer corresponding to the middle term. I will now show you by an example.

Example.

1. If 9 persons spend 120*l.* in 8 months, how much will 24 persons spend in 16 months?

Stated thus:

	Persons.		£		Persons.
As	+ 9	:	120	::	24
	+ 8	:	——	::	16

Here, by the nature of the question *money* is required for the answer, therefore *money* must be the *middle* term; 9 persons is the term used for *supposition;* 24 persons the one of *demand,* and as they are both of the same name require no reducing.

Again, by the question, if 9 persons spend 120*l.*, 24 persons will spend *more* than 120*l.*; therefore I mark the *less* of the two outer terms for a divisor.

I then proceed with the next stating in the same manner, using the *middle* term in common with every stating, thus: if in 8 months 120*l.* are required, how much is required for 16 months? which of course is *more* than 120*l.*; again, I therefore mark the *less* of the two *outer* terms as before *for a divisor.*

In the next place, I collect the terms not marked, and multiply them for a *dividend*, and those that are marked for a *divisor*, and the work stands as below:—

```
             £
            120
             24
            ---
            480
           240
           ----
           2880
             16
           -----
   9      17280
   8      2880    £
  --      -----
  72)     46080(640 Answer.
          432
          ---
          288
          288
          ---
            0
```

I shall now give you another example containing 3 statings.

Example.

2. If a garrison of 3,600 men in 35 days, at 24 ozs. per day each man, eat a certain quantity of bread; how many men in 45 days, at the rate of 14 ozs. per day each man, will eat double the quantity?

Stated thus:

```
                        Men.
As    35 days      :    3600    ::   45 days. +
       24 ozs.     :    ——      ::   14 ozs.  +
    + 1 quantity   :    ——      ::    2 quantities.
                        3600
                          35
                       ------
                       18000
                      10800
                      -------
                      126000
                          24
                      -------
          45           504000
          14          252000
         ----         -------
         180          3024000
         45                 2
        -----         -------  Men.
         630)         6048000(9600 Answer.
                      567
                      ----
                      ·378
                       378
                      -----
                       ··00
```

You may also perform this example by the following method, which is called *cancelling*, and save a great deal of labour:—

Put down each term of the dividend with a sign of multiplication between them, draw a line under them, and beneath it place the terms of the divisor. Find a number that will divide one of the *upper* terms and one of the *lower* without a remainder, put down the *quotients* instead, and draw a line through the numbers divided, and in this way reduce every term as low as you can. Multiply all the *top* numbers for the dividend, and *the lower* ones for a divisor, and divide one by the other, the quotient is the answer, like the middle term of your statings, thus:—

$$\frac{\overset{5}{\cancel{35}} \times \overset{80}{\cancel{3600}} \times 24 \times \cancel{2}}{\cancel{45} \times \underset{\cancel{2}}{\cancel{14}} \times 1} = 80 \times 24 \times 5 = 9600 \text{ men.}$$

You will find this rule exceedingly useful when you come to fractions, as well as in this rule.

LAVINIA.

There appears much in this rule that I learned under Simple Proportion.

CONSTANTIA.

Certainly, my dear; for it must of necessity be similar to it in many things, and though it is probable you will never be required to use it much, I think it as well to explain it to you.

LAVINIA.

Thank you: it is not at all unlikely that either master Harry, or Edward, may try to puzzle me in this, as they told me the other day that they intended to give me a severe examination at Christmas, when the long dark evenings will prevent their going out to play cricket. You have not said what is the meaning of those *dots* that you place *between each* term of the stating.

CONSTANTIA.

I am glad you remind me of it; they are used to denote proportion, thus:

As 2 : 4 :: 8 : 16

Which means, that 2 bears the same proportion to 4 as 8 does to 16. And are read thus: as 2 is to 4, so is 8 to 16.

For the present, I must say adieu, and leave you to work the examples that I have written for you.

Examples.

3. If 100*l.* in one year gain 5*l.* interest, what will be the interest of 800*l.* for 6 years?

4. If 130 bushels of corn will serve 16 horses 54 days, how many days will 98 bushels serve 5 horses?

5. A barrel of beer was sufficient to last a family of 8 persons 12 days, how many barrels will be drunk by 18 persons in the year?

6. A regiment of soldiers, consisting of 1,568, consumed 694 quarters of wheat in 330 days, how much will an army of 20,550 soldiers consume on a march of 120 days?

7. If 9 pieces of cannon carrying 24 pounders, can beat down a castle wall in 2 hours, how long would it take 12 pieces carrying 18 pounders, to beat down the same wall, if each cannon fired the

same number of times, the balls flying at the same velocity?

8. If 250 men in 6 days of 10 hours each, dig a trench of 5 degrees of hardness, 70 yards long, 3 wide, and 2 deep; what length of 6 degrees of hardness, 5 yards wide, and 3 deep, will be dug by 210 men in 8 days of 12 hours each?

9. If, when wine is 30*l.* per tun, 20*l.* worth serve a ship's crew of 336 men for 4 days, at a pint a day each man; how long will 500*l.* worth serve a crew of 250 men at 1½ pint a day to each man?

10. If 4 compositors in 16 days of 12 hours long, can compose 14 sheets of 24 pages in each sheet, 44 lines in a page, and 40 letters in a line; in how many days of 10 hours long, may 9 compositors compose a volume to be printed on the same letter, consisting of 30 sheets, 16 pages in a sheet, 48 lines in a page, and 45 letters in a line?

11. If the carriage of 150 lbs. for 100 miles cost 7*s.* 6*d.*, how many pounds can I have carried 600 miles for 1*l.* 10*s.* 6*d.*?

CONVERSATION XXIV.

ON PRACTICE.

CONSTANTIA.

THIS rule takes its name from the general use it obtains in business by its concise and practical application, and is performed by dividing the quantity given by the aliquot, or even part of any given price; the following are some of the numbers used in dividing, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c., which is the same as dividing by 2, 3, 4, 5, &c.; but before you can perform this rule with ease, you must learn perfectly the tables of aliquot parts, which I shall give you.

A TABLE OF THE ALIQUOT PARTS OF MONEY.

OF A POUND.				OF A SHILLING.		
s.	*d.*		£	*d.*		
10	0	=	$\frac{1}{2}$	6	=	$\frac{1}{2}$
6	8	=	$\frac{1}{3}$	4	=	$\frac{1}{3}$
5	0	=	$\frac{1}{4}$	3	=	$\frac{1}{4}$
4	0	=	$\frac{1}{5}$	2	=	$\frac{1}{6}$
3	4	=	$\frac{1}{6}$	$1\frac{1}{2}$	=	$\frac{1}{8}$
2	6	=	$\frac{1}{8}$	1	=	$\frac{1}{12}$
2	0	=	$\frac{1}{10}$	OF A PENNY.		
1	8	=	$\frac{1}{12}$	$\frac{1}{4}$	=	$\frac{1}{4}$
1	4	=	$\frac{1}{15}$	$\frac{1}{2}$	=	$\frac{1}{2}$

LAVINIA.

I think you will find me perfect in the last task you gave me, and I shall be glad to have you explain to me the rule.

CONSTANTIA.

That shall be done with pleasure. Suppose I buy 12 yards of velvet at 1*l.* a yard, I must of course give 12*l.* for the whole; but if I paid 10*s.* a yard, it would cost only *half* that amount. Now, if I divide the 12 by 2, it gives me 6*l.* and the work is placed in this manner.

s. yds.
10 = $\frac{1}{2}$) 12
£ 6 price at 10*s.* per yard.

Whatever name you take, an aliquot part of the *quotient* is always of the same name, for 10*s.* is half 1*l.*, therefore the quotient is 6*l.*; if any remainder, you reduce it to the next lower name, as in division of money.

On the same principle, if I give 5*s.* a dozen for 20 dozen of gloves, I give $\frac{1}{4}$ as many pounds, because 5*s.* is $\frac{1}{4}$ of a pound, thus:—

s.
5 = $\frac{1}{4}$) 20
£ 5 Answer.

In this way you may calculate any number of things at any other price, say 4614 yards of lace at 4*d.* a yard, it would stand thus:—

d.
4=⅓) 4614
2,0) 153,8
£76 18*s.* Answer.

Here the quotient consists of shillings, because 4*d.* is the aliquot part of a shilling, which is brought into pounds by Reduction.

There are several forms of this rule which I shall divide as follows:—

RULE I.—*When the price is less than a penny:* multiply the given quantity by the number of farthings, and reduce them to pounds; or, divide by the aliquot part of a penny, and reduce them to pounds.

RULE II.—*When the price is an aliquot part of a shilling,* divide by the aliquot part, and that quotient by 20.

RULE III.—*When the price is pence and farthings, and not an aliquot part of a shilling,* divide the given quantity by some aliquot part of a shilling; then consider what part of this aliquot part the rest is, and divide the quotient by it, and this quotient added to the other will give the answer in shillings which divide by 20.

RULE IV.—*When the price is more than a* *shilling, but less than two;* let the given quantity stand for shillings, and work for the pence and farthings as before.

RULE V.—*When the price is any even number of shillings under* 20, multiply the quantity by *half* the price, double the first figure in the quotient for shillings, and the rest will be pounds; but *when the price is not an even number of shillings,* multiply by the shillings, and divide by 20 for the answer.

RULE VI.—*When the price is shillings and pence;* if they are an aliquot part of a pound, divide the quantity by that aliquot part, and the quotient will be the answer. If they are not an aliquot part, multiply by the shillings, and take parts for the rest, and divide by 20 for the answer.

RULE VII.—*When the price is pounds, shillings, pence, and farthings;* multiply the quantity by the pounds, and proceed with the rest as in the former rules; when the given quantity consists of two or three figures, multiply the price by the quantity, as in Compound Multiplication.

RULE VIII.—If there be a fraction in the quantity, work for the whole number by the former rules, and find the product of the fraction by multiplying the price by the *numerator,* and dividing that product by the *denominator,* then add this quotient to the other products for the answer.

RULE IX.—*When the quantity is of several denominations;* multiply the price by the highest denomination as you did in Compound Multiplication, and take parts of the given price for the inferior denominations, and their sums will be the true value.

Before you proceed to Rule the IXth, you must learn the following table. In the examples which follow each rule I have worked one at length, to show you the nature of the operation.

A TABLE OF THE ALIQUOT PARTS OF WEIGHTS AND MEASURES.

AVOIRDUPOIS WEIGHT.

OF A TON.

cwt.
10 = $\frac{1}{2}$
5 = $\frac{1}{4}$
4 = $\frac{1}{5}$
2$\frac{1}{2}$ = $\frac{1}{8}$
2 = $\frac{1}{10}$

OF A CWT.

qrs. lbs.
2 or 56 = $\frac{1}{2}$
1 or 28 = $\frac{1}{4}$
16 = $\frac{1}{7}$
14 = $\frac{1}{8}$

OF $\frac{1}{2}$ CWT. OR 56 POUNDS.

lbs.
28 = $\frac{1}{2}$
14 = $\frac{1}{4}$
8 = $\frac{1}{7}$
7 = $\frac{1}{8}$

OF $\frac{1}{4}$ CWT. OR 28 POUNDS.

lbs.
14 = $\frac{1}{2}$
7 = $\frac{1}{4}$
4 = $\frac{1}{7}$
3$\frac{1}{2}$ = $\frac{1}{8}$

OF A POUND.

oz.
8 = $\frac{1}{2}$
4 = $\frac{1}{4}$
2 = $\frac{1}{8}$

TROY WEIGHT.

OF AN OUNCE.

dwts. grs.
10 0 = $\frac{1}{2}$
6 16 = $\frac{1}{3}$
5 0 = $\frac{1}{4}$
4 0 = $\frac{1}{5}$
3 8 = $\frac{1}{6}$
2 12 = $\frac{1}{8}$
2 0 = $\frac{1}{10}$
1 16 = $\frac{1}{12}$

OF A DWT.

grs.
12 = $\frac{1}{2}$
8 = $\frac{1}{3}$
6 = $\frac{1}{4}$
4 = $\frac{1}{6}$
3 = $\frac{1}{8}$
2 = $\frac{1}{12}$

LAND MEASURE.

OF AN ACRE.

r. p.
2 0 = $\frac{1}{2}$
1 0 = $\frac{1}{4}$
32 = $\frac{1}{5}$
20 = $\frac{1}{8}$
16 = $\frac{1}{10}$
8 = $\frac{1}{20}$

CLOTH MEASURE.

OF A YARD.

qrs. nls.
2 0 = $\frac{1}{2}$
1 0 = $\frac{1}{4}$
2 = $\frac{1}{8}$
1 = $\frac{1}{16}$

OF AN ENGLISH ELL.

qrs. nls.
2 2 = $\frac{1}{2}$
1 1 = $\frac{1}{4}$
1 0 = $\frac{1}{5}$
2 = $\frac{1}{10}$
1 = $\frac{1}{20}$

OF A FLEMISH ELL.

qrs. nls.
1 2 = $\frac{1}{2}$
1 0 = $\frac{1}{3}$
3 = $\frac{1}{4}$
2 = $\frac{1}{6}$
1 = $\frac{1}{12}$

OF A FRENCH ELL.

qrs. nls.
3 0 = $\frac{1}{2}$
2 0 = $\frac{1}{3}$
1 2 = $\frac{1}{4}$
1 0 = $\frac{1}{6}$
3 = $\frac{1}{8}$
2 = $\frac{1}{12}$
1 = $\frac{1}{24}$

Examples.

RULE I.

1. What cost 6195 yards of linen tape at ¼*d.* per yard?

| ¼ | ¼ | 6195
12)1548¾
2,0) 129
Answer 6*l.* 9*s.* 0¾*d.*

2. 4168 at ¼*d.* | 3. 6210 at ½*d.*
4. 3176 at ¾*d.*

RULE II.

5. 6403 yards at 1*d.*

| 1*d.* | $\frac{1}{12}$ | 6403
2,0) 53,3–7
Answer 26*l.* 13*s.* 7*d.*

6. 2150 at 1½*d.* | 8. 1025 at 3*d.*
7. 4267 at 2*d.* | 9. 2639 at 4*d.*
10. 1654 at 6*d.*

RULE III.

11. 428 at 1¼*d.*

| 1*d.* ¼ | $\frac{1}{12}$ ¼ | 428
35–8
8–11
2,0)4,4–7
Answer 2*l.* 4*s.* 7*d.*

12. 6140 at 1¼*d.*
13. 2916 at 1¾*d.*
14. 1029 at 2¼*d.*
15. 4163 at 2½*d.*
16. 1487 at 2¾*d.*
17. 6542 at 3¼*d.*
18. 1843 at 3½*d.*
19. 1483 at 3¾*d.*
20. 1384 at 4¼*d.*
21. 6215 at 4½*d.*
22. 4706 at 4¾*d.*
23. 1245 at 5*d.*
24. 2716 at 5¼*d.*
25. 1374 at 5½*d.*
26. 268 at 5¾*d.*
27. 4961 at 6¼*d.*
28. 3124 at 6½*d.*
29. 5216 at 6¾*d.*
30. 4379 at 7*d.*
31. 2165 at 7¼*d.*
32. 1415 at 7½*d.*
33. 5196 at 7¾*d.*
34. 9170 at 8¼*d.*
35. 4262 at 8½*d.*
36. 3187 at 8¾*d.*
37. 4219 at 9*d.*
38. 6362 at 9¼*d.*
39. 1027 at 9¾*d.*
40. 1286 at 10¼*d.*
41. 3025 at 10¾*d.*
42. 9417 at 11*d.*
43. 6128 at 11¼*d.*
44. 7265 at 11¾*d.*

RULE IV.

45. 3186 at 12¼*d.*

```
| ¼ | 1/48 |  3186
                66 4½
             ----------
       2,0)325,2 4½
             ------------------
Answer 162l. 12s.  4½d.
```

46. 2178 at 12½*d.*
47. 319 at 12¾*d.*
48. 6512 at 13*d.*
49. 3185 at 13¼*d.*
50. 2149 at 13½*d.*
51. 1960 at 13¾*d.*
52. 2137 at 14*d.*
53. 6198 at 14¼*d.*
54. 2596 at 14½*d.*
55. 1738 at 14¾*d.*
56. 2896 at 15*d.*
57. 1964 at 15¼d.

58. 2153 at 15½*d.*
59. 1769 at 15¾*d.*
60. 4180 at 16*d.*
61. 3446 at 16¼*d.*
62. 1985 at 16½*d.*
63. 2185 at 16¾*d.*
64. 4318 at 17*d.*
65. 129 at 17¼*d.*
66. 480 at 17½*d.*
67. 1859 at 17¾*d.*
68. 6217 at 18*d.*
69. 5430 at 18¼*d.*
70. 1325 at 18½*d.*
71. 2186 at 18¾*d.*
72. 1010 at 19*d.*
73. 2166 at 19¼*d.*
74. 4023 at 19½*d.*
75. 2617 at 20*d.*
76. 3198 at 20¼*d.*
77. 210 at 20½*d.*
78. 365 at 20¾*d.*
79. 4129 at 21*d.*
80. 4726 at 21½*d.*
81. 4196 at 21¾*d.*
82. 5486 at 22*d.*
83. 6163 at 22½*d.*
84. 5210 at 22¾*d.*
85. 7189 at 23*d.*
86. 7215 at 23¼*d.*
87. 219 at 23½*d.*
88. 4126 at 23¾*d.*

RULE V.

89. 4196 at 4*s.*

```
         4196
            2
Answer  839l.  4s.
```

90. 4120 at 7*s.*

```
         4120
           3½
        12360
         2060
Answer  1442l.
```

91. 692 at 2*s.*
92. 375 at 4*s.*
93. 4681 at 6*s.*
94. 165 at 9*s.*
95. 2176 at 10*s.*
96. 4428 at 12*s.*
97. 2163 at 13*s.*
98. 521 at 14*s.*
99. 693 at 16*s.*
100. 7250 at 18*s.*
101. 412 at 19*s.*
102. 546 at 20*s.*

RULE VI.

103. 2186 at 2*s*. 6*d*.

```
| 2s. 6d. | ⅛ | 2186
               ________
    Answer     273l. 5s.
```

104. 4128 at 4*s*., 6*d*.

```
| 6d. | ½ | 4128
               4
            -----
            16512
             2064
            -----
      2,0)1857,6
    Answer 928l. 16s.
```

		s.	*d.*
105.	1426 at	2	6
106.	2193 at	3	4
107.	4219 at	5	0
108.	2638 at	6	8
109.	185 at	7	6
110.	257 at	8	6
111.	2173 at	9	6
112.	4280 at	10	0
113.	3962 at	12	9
114.	4128 at	13	4

RULE VII.

115. 3215 at 2*l*. 16*s*. 4½*d*.

```
  s. d.
|10 0 | ½ | 3215
                2
             ----
             6430
|  5 0 | ½ | 1607 10
|  1 0 | ⅕ |  803 15
|  0 4 | ⅓ |  160 15
|  0 0½| ⅛ |   53 11  8
                6 13 11½
            ------------
Answer      9062l. 5s. 7½d.
```

		£	*s.*	*d.*
116.	342 at	3	16	10½
117.	189 at	2	12	8¾
118.	4169 at	5	14	10¼
119.	213 at	6	12	7¾
120.	4196 at	4	18	8½

			£	s.	d.
121.	7132	at	4	13	7$\frac{1}{4}$
122.	6141	at	5	9	9$\frac{1}{4}$
123.	741	at	13	1	9$\frac{1}{4}$
124.	8126	at	18	12	3$\frac{3}{4}$

Rule VIII.

125. 2152$\frac{2}{3}$ at 2*l.* 17*s.* 10*d.*

s.	d.						£	s.	d.
			2152						
10	0	$\frac{1}{2}$	2						
			4304			value at	2	0	0
5	0	$\frac{1}{2}$	1076			value at	0	10	0
2	6	$\frac{1}{2}$	538			value at	0	5	0
0	3	$\frac{1}{10}$	269			value at	0	2	6
0	1	$\frac{1}{3}$	26	18	0	value at	0	0	3
			8	19	4	value at	0	0	1
			1	18	6$\frac{1}{2}$	value at	0	0	0$\frac{2}{3}$

Answer 6224*l.* 15*s.* 10$\frac{1}{2}$*d.*

	£	s.	d.
	2	17	10
			2
3)	5	15	8
	1	18	6$\frac{1}{2}$-2

			£	s.	d.
126.	4234$\frac{1}{2}$	at	2	13	4$\frac{1}{2}$
127.	32190$\frac{1}{3}$	at	3	12	9$\frac{3}{4}$
128.	4492$\frac{1}{2}$	at	2	16	6$\frac{1}{4}$
129.	3760$\frac{3}{4}$	at	4	12	8$\frac{1}{2}$
130.	2195$\frac{3}{5}$	at	6	17	10$\frac{1}{4}$
131.	218$\frac{4}{7}$	at	8	13	5$\frac{3}{4}$
132.	643$\frac{5}{8}$	at	9	19	10$\frac{1}{2}$
133.	218$\frac{6}{7}$	at	4	12	11$\frac{1}{4}$
134.	4283$\frac{11}{16}$	at	19	19	11$\frac{3}{4}$

RULE IX.

135. What is the value of 12 cwt. 3 qrs. 16 lbs. of tobacco, at 4*l.* 12*s.* per cwt.?

qrs.	lbs.		£	s.	d.		
2	0	½	4	12	0		
					12		
			55	4	0		value of 12 cwt.
1	0	½	2	6	0		value of 2 qrs.
0	16	$\frac{1}{7}$	1	3	0		value of 1 qr.
				13	1½	– 6	value of 16 lb.
		Answer	£59	6	1½		

136. What is the value of 5 cwt. 3 qrs. 17 lbs. of soap, at 2*l.* 17*s.* 8*d.* per cwt.?

137. What is the value of 16 cwt. 3 qrs. 15 lbs. of tea, at 19*l.* 16*s.* 6*d.* per cwt.?

138. What is the value of 11 cwt. 1 qr. 19 lbs. of sugar, at 2*l.* 10*s.* 6*d.* per cwt.?

139. What is the value of 7 tons 11 cwt. 3 qrs. 1 lb. of cheese, at 48*l.* 17*s.* 9*d.* a ton?

140. What is the value of 2 qrs. 17 lbs. 10 oz., at 3*l.* 17*s.* 6*d.* per cwt.?

141. What is the value of 17 lbs. 6 oz. 13 dwts. of silver, at 3*l.* 5*s.* per lb.?

142. What is the value of 15 hhds. of wine, at 25*l.* 10*s.* per hhd.?

143. What is the value of 19 acres 3 rds. 14 pls. of land, at 31*l.* 17*s.* 6*d.* per acre?

144. What is the value of 37 yds. 3 qrs. 2 nls., at 5*s.* 9½*d.* per yard?

145. What is the value of 173 tuns 3 hhds. 17 gals., at 17*l.* 14*s.* 3*d.* per tun?

146. What is the value of 217 ells Flemish, 1 qr., at *5s.* 7½*d.* per ell?

147. What is the value of 235 ells English, 3 qrs. 1 nl., at 7*s.* 10½*d.* per ell?

148. What is the value of 182 hhds. 32 gls. 1 pt., at 4*l.* 16*s.* 6*d.* per hhd.?

149. What is the value of 93 barrels 17 gls. 2 pints, at 1*l.* 16*s.* 8*d.* per barrel?

150. What is the value of 429 square yds. 7 feet 117 inches, at 9*s.* 7½*d.* per yard?

These examples, Lavinia, terminate the Rule of Practice, and may all be performed by Direct Proportion; on the contrary, all those examples which have 1 for the *first* term in Direct Proportion may be performed by this rule.

CONVERSATION XXV.

ON VULGAR FRACTIONS.

CONSTANTIA.

We now come to the Rule called Fractions, which signify broken parts, or rather parts of any whole thing. If you divide an orange into three *equal* parts, and give one part to your sister, you give her a fraction of it; if you give your brother another part, he has a fraction of it also; and a fraction of it remains to yourself. But you are not to understand that a fraction is the part of an *orange* only; it may be part of a pound, a shilling, a penny, a yard, &c., or of any whole thing whatsoever; and when you understand this Rule, you will be able to determine the value of any *whole* thing, if the value of a *part* only is given.

LAVINIA.

I see this very clearly.

CONSTANTIA.

In every fraction there is a numerator and a denominator, thus, $\frac{2}{3}$, called two thirds; the *upper* figure is the numerator, and the *lower* the *denominator.*

Fractions are of six kinds, viz.—Proper, Improper, Simple, Compound, Mixed, and Complex.

1. A *Proper* fraction has the numerator less than the denominator, as $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, &c.

2. An *Improper* fraction is when the numerator is equal to, or greater than the denominator, as $\frac{3}{3}$, $\frac{6}{5}$, or $\frac{19}{11}$, &c. When the numerator is equal to the denominator, the fraction is equal to 1; but when the denominator is greater than the numerator, it is greater than 1.

3. A *Simple* fraction is a fraction which expresses the number by one numerator and one denominator, as $\frac{2}{3}$, &c.

4. A *Compound* fraction is the fraction of a fraction, or two or more fractions joined together by the word *of*, as $\frac{1}{2}$ of $\frac{2}{3}$, of $\frac{3}{4}$, of $\frac{5}{7}$, &c.

5. A *Mixed* number consists of a whole number and a fraction, as $2\frac{1}{3}$, $5\frac{2}{5}$, &c.

6. A *Complex* fraction has a mixed fraction for its numerator or denominator, and very frequently both, as $\frac{\frac{1}{2}}{5}$, $\frac{\frac{4}{5}}{\frac{17}{21}}$, $\frac{4\frac{1}{6}}{9\frac{3}{7}}$, &c. Any whole number may be expressed like a fraction, by writing 1 beneath it for a denominator, thus—6 is the same as $\frac{6}{1}$, or 10 is equal to $\frac{10}{1}$.

LAVINIA.

But how am I to understand what part the fraction is of the *whole thing* which it represents?

CONSTANTIA.

It is understood thus:—The denominator shows the number of parts any whole thing is divided into, and the numerator shows how many of those parts are taken. Suppose you divide an orange into 6 parts, and give me *one* of them, the fraction would stand thus, $\frac{1}{6}$, the denominator showing into how many parts the orange was divided, and the numerator how many were taken away; if you gave me 3 out of 6, it would stand thus, $\frac{3}{6}$ or $\frac{1}{2}$ the orange, or you may see the rule by the following simple diagram: —

1	2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6	7	8	9	10	11	12

The line is divided into 12 equal parts, which are shown by the figures below, and the figures above show how many of those parts may be taken.

Let us, for example, take an orange again, and divide it into 12 equal parts: now if I take away 5 parts from the 12, I leave $\frac{7}{12}$ths; if I take 8 parts, I leave $\frac{4}{12}$ths; and if I take 12 parts, I take $\frac{12}{12}$ths, or the whole orange; for when the numerator and denominator are alike, it is equal to 1, or the whole of any thing. All fractions are founded on this principle, though they are very often complicated in their arrangement. We must now proceed to the first Rule, which is called Reduction.

LAVINIA.

How very strange! Do you do Reduction before Addition?

CONSTANTIA.

Yes, Lavinia; there are so many various forms in fractions, that before they can be used they must be reduced from one denomination to another, to prepare them for those rules.

Reduction of Fractions, like Simple Reduction, never alters the value of any thing it changes, but changes only the denomination; and if you multiply or divide both terms of a fraction by the same number, the value of it is not changed.

CASE I.—To find the greatest common measure of a fraction.

The common measure of a fraction is the number which will divide both the numerator and the denominator without a remainder; and the greatest number that will do this, is the greatest common measure: in the fraction $\frac{8}{24}$, 8 is the greatest common measure; for if the fraction is divided by it, the result will be $\frac{1}{3}$, which is equal in value to $\frac{8}{24}$, so you see Reduction changes the fraction without altering its value, and it often saves a great many figures.

Rule.—Divide the greater term of the fraction by the less; then divide the *divisor* by the *remainder*, and continue to divide the last *divisor* by the last remainder till nothing remains: the last *divisor* is the greatest common measure. When the last divisor is 1, the fraction has no common measure, but is already in its lowest terms.

If there be an equal number of ciphers in the numerator and denominator, they may be cut off without altering the value of the *fraction,* thus: $\frac{3|0}{4|0}=\frac{3}{4}$.

Examples.

1. First, the greatest common measure of $\frac{216}{618}$.

```
216)618(2
    432
    186)216(1
        186
        ·30)186(6
            180
            ··6)30(5
                30
                ··
```

Here 6 being the last divisor, it is the greatest common measure.

2. What is the greatest common measure of $\frac{316}{856}$?

3. What is the greatest common measure of $\frac{522}{630}$?

4. Find the greatest common measure of $\frac{2187}{13193}$.

5. Find the greatest common measure of $\frac{2400}{4150}$.

6. What is the greatest common measure of $\frac{8963}{31236}$?

Case II. — To reduce fractions to their lowest terms; that is, to reduce the numerator and denominator by a number that will divide both without a remainder, and leave the fraction so that no other number can reduce it lower.

Rule. — Divide the numerator and denominator of the *fraction* by their greatest common measure.

To explain this, I shall take the example in case the first.

Examples.

7. Reduce $\frac{216}{618}$ to its lowest terms.

Com. mea. $6)\frac{216}{618}(\frac{36}{103}$ lowest terms — Answer.

You will observe no number will divide this fraction again except 1, therefore it is in its lowest terms.

8. Reduce $\frac{192}{780}$ to its lowest terms.
9. Reduce $\frac{212}{858}$ to its lowest terms.
10. Reduce $\frac{3704}{646}$ to its lowest terms.
11. Reduce $\frac{510}{7198}$ to its lowest terms.
12. Reduce $\frac{182}{1196}$ to its lowest terms.
13. Reduce $\frac{468}{1184}$ to its lowest terms.

CASE III. — To reduce a mixed number to an improper fraction.

Rule. — Multiply the whole number by the denominator of the fraction and add in the numerator, and *beneath* this sum place the denominator, and you will have the fraction required.

Examples.

14. Reduce $4\frac{5}{6}$ to an improper fraction.

$$\begin{array}{l} 4\frac{5}{6} \\ 6 \\ \hline \frac{29}{6} \text{ Answer.} \\ \hline \end{array}$$

15. Reduce $7\frac{1}{9}$ to an improper fraction.
16. Reduce $11\frac{5}{7}$ to an improper fraction.

17. Reduce $23\frac{6}{11}$ to an improper fraction.
18. Reduce $45\frac{16}{20}$ to an improper fraction.
19. Reduce $539\frac{215}{719}$ to an improper fraction.
20. Reduce $2631\frac{4}{8799}$ to an improper fraction.

CASE IV. — To reduce an improper fraction to a whole or mixed number.

Rule. — Divide the numerator by the denominator, and the quotient will be the whole or mixed number; when there is a remainder, place the divisor beneath it for the fractional part.

Examples.

21. Reduce $\frac{29}{6}$ to a mixed number.

$$\begin{array}{r} 6\,)\,\underline{29} \\ \underline{4\frac{5}{6}} \end{array}$$

This rule, you observe, is just the reverse of the last; and I have made use of the same example to show you more clearly.

22. Reduce $\frac{156}{11}$ to a mixed number.
23. Reduce $\frac{219}{17}$ to its proper terms.
24. Reduce $\frac{964}{123}$ to its proper terms.
25. Reduce $\frac{45631}{99}$ to its proper terms.
26. Reduce $\frac{21969}{334}$ to a mixed number.
27. Reduce $\frac{2262}{58}$ to a whole number.

CASE V. — To reduce a complex fraction to a simple one.

Rule. — If the numerator or the denominator, or both, consist of a whole or a mixed number, reduce them to improper fractions by Case the 3rd; then *invert* the fraction which forms the *denominator*, and multiply the numerators together for a single numerator, and the denominators for a single denominator.

Examples.

28. Reduce $\frac{6\frac{3}{7}}{8\frac{2}{3}}$ to a simple fraction.

First, $6\frac{3}{7} = \frac{45}{7}$ and $8\frac{2}{3} = \frac{26}{3}$.

Then, $\frac{45}{7} \times \frac{3}{26} = \frac{135}{182}$ Answer.

The examples under this rule are of various forms, a few of which I will give you,—

Thus, $\frac{8\frac{2}{9}}{4\frac{1}{5}} = \frac{\frac{74}{9}}{\frac{21}{5}} = \frac{74}{9} \times \frac{5}{21} = \frac{370}{819}$.

Again, $\frac{52}{63\frac{4}{5}} = \frac{\frac{52}{1}}{\frac{319}{5}} = \frac{52}{1} \times \frac{5}{319} = \frac{260}{319}$.

And, $\frac{24\frac{6}{7}}{75} = \frac{\frac{174}{7}}{\frac{75}{1}} = \frac{174}{7} \times \frac{1}{75} = \frac{174}{525} = \frac{78}{175}$.

I think, however, these will give you a clear view of what many young ladies consider a very difficult part of Arithmetic; but they are frightened at the appearance rather than the reality; for there is nothing difficult about it when clearly explained.

29. Reduce $\frac{4\frac{2}{3}}{6\frac{3}{4}}$ to a simple fraction.

30. Reduce $\frac{33}{96\frac{1}{2}}$ to a simple fraction.

31. Reduce $\frac{297\frac{1}{8}}{67}$ to a simple fraction.

32. Reduce $\frac{59\frac{4}{13}}{68\frac{7}{11}}$ to a simple fraction.

33. Reduce $\frac{\frac{3}{4}}{93\frac{1}{8}}$ to a simple fraction.

34. Reduce $\frac{\frac{317}{512}}{162\frac{31}{45}}$ to a simple fraction.

35. Reduce $\frac{617}{\frac{5}{11}}$ to a simple fraction.

36. Reduce $\frac{51\frac{4}{9}}{\frac{2}{7}}$ to a simple fraction.

Case VI. — To reduce a compound fraction to a simple one.

Rule. — First see if any of your fractions be integers (that is *whole* numbers), mixed numbers, or complex fractions, and reduce them by the former rules; then multiply all the numerators together for a new numerator, and all the denominators for a new denominator, and reduce this fraction to its lowest terms; or you may cancel any figures that are found in the numerators and denominators, and make use of their quotients, as directed in Compound Proportion: this is very important in fractions, as it saves a great deal of trouble.

Examples.

37. Reduce $\frac{2}{3}$ of $\frac{5}{7}$ of $\frac{8}{11}$ to a simple fraction.

$\frac{2 \times 5 \times 8}{3 \times 7 \times 11} = \frac{80}{231}$ Answer.

38. Reduce $\frac{3}{4}$ of 8 of $5\frac{1}{6}$ of $\frac{9}{10}$ to a simple fraction.

First, $8=\frac{1}{8}$ and $5\frac{1}{6}=\frac{31}{6}$

$$\frac{\cancel{3}\times\overset{\cancel{2}}{\cancel{8}}\times 31\times 9}{\cancel{4}\times 1\times\underset{\cancel{2}}{\cancel{6}}\times 10}=\frac{279}{10}\text{ Answer.}$$

39. Reduce $\frac{2}{3}$ of $\frac{4}{7}$ of $\frac{6}{11}$ to a simple fraction.

40. Reduce $\frac{7}{10}$ of $\frac{11}{16}$ of $\frac{4}{17}$ to a simple fraction.

41. Reduce $4\frac{1}{2}$ of 6 of $3\frac{4}{7}$ to a simple fraction.

42. Reduce $12\frac{3}{8}$ of $31\frac{9}{16}$ of $29\frac{23}{47}$ to a simple fraction.

43. Reduce $\frac{4}{7}$ of 14 of $6\frac{7}{19}$ to a simple fraction.

44. Reduce $\frac{3\frac{4}{5}}{12\frac{1}{7}}$ of $\frac{\frac{7}{8}}{\frac{5}{12}}$ of 37 to a simple fraction.

Case VII.—To reduce a whole number to a fraction of a given denominator.

Rule.—Multiply the whole number by the given denominator, and the product will be the numerator required.

Examples.

45. Reduce 12 to an improper fraction, having 25 for its denominator.

$$\begin{array}{r}25\\ 12\\ \hline 300\\ \hline 25\\ \hline\end{array}\text{ Answer.}$$

46. Reduce 6 to an improper fraction, having 43 for its denominator.

47. Reduce 31 to an improper fraction, having for its denominator 63.

CASE VIII.—To find the value of a fraction in the known parts of an integer.

Rule.—Multiply the given quantity by the numerator, and divide that product by the denominator; if there be any remainder reduce it to the next lower denomination, and divide by the denominator as before; proceed thus till you come to the lowest denomination.

Examples.

48. What is the value of $\frac{2}{3}$ of a shilling?

$$\begin{array}{r l} & \textit{d.} \\ & 12 \\ & \underline{2} \\ 3) & \underline{24} \\ & 8 \text{ Answer } 8\textit{d.} \end{array}$$

Or thus,

$$\begin{array}{r l} & \textit{d.} \\ 3) & \underline{12} \\ & 4 \\ & \underline{2} \\ \text{Answer,} & 8 \text{ as before.} \end{array}$$

49. What is the value of $\frac{3}{4}$ of a pound?
50. What is the value of $\frac{5}{7}$ of a guinea?
51. What is the value of $\frac{4}{16}$ of a groat?
52. What is the value of $\frac{11}{13}$ of 5 guineas?
53. What is the value of $\frac{2}{3}$ of $\frac{3}{4}$ of a sovereign?
54. What is the value of $\frac{5}{16}$ of a moidore?
55. Reduce to its proper quantity $\frac{7}{9}$ of a lb. Troy.
56. Reduce $\frac{12}{23}$ of a ton to its proper quantity.

57. Reduce to its proper quantity $\frac{3}{4}$ of a pipe of wine.

58. Reduce to its proper quantity $\frac{4}{5}$ of 3 cwt. 2 qrs. 16 lbs.

59. Reduce $\frac{2}{7}$ of a mile to its proper quantity.

60. Reduce $\frac{9}{10}$ of 3 yds. 2 qrs. 1 nl. to its proper quantity.

61. Reduce $\frac{8}{11}$ of a yard to its proper quantity.

62. Reduce $\frac{2}{3}$ of a month to its proper quantity.

63. Reduce $\frac{5}{8}$ of a ton of coals to its proper quantity.

64. Reduce $\frac{9}{11}$ of a yard to its proper quantity.

CASE IX.—To reduce coins, weights, and measures into fractions.

Rule.—Reduce the given sum, weight, or measure, into the lowest terms mentioned for a numerator, and reduce the given *integer* to the same name for a denominator, and that fraction will be the answer; when a fraction is given at the end of a quantity, reduce both the quantity and the integer to the number of parts contained in the *denominator* of the fraction, and add the *numerator* of the given fraction to the product for the numerator.

Examples.

65. Reduce 5*s.* 6½*d.* to the fraction of a pound.

s.	*d.*	*s.*
5	6½	20 integer
12		12
66		240
4		4
266 Numerator.		960 Denominator.

$$\text{Answer, } \frac{266}{960}=\frac{130}{480} \text{ pound, or } \frac{13}{48}$$

66. Reduce 4*s.* $6\frac{1}{2}$*d.* $\frac{3}{5}$ to the fraction of a pound.

s.	*d.*	*s.*	
4	$6\frac{1}{2}$ $\frac{3}{5}$	20	integer
12		12	
54		240	
4		4	
218		960	
5		5	
1093	Numerator.	4800	Denominator.

Answer, $\frac{1093}{4800}$ pound.

67. Reduce 6*s.* 8*d.* to the fraction of a pound.

68. Reduce 1*s.* 4*d.* to the fraction of a pound.

69. Reduce 17*s.* $11\frac{1}{2}$*d.* $\frac{2}{7}$ to the fraction of a pound.

70. Reduce $4\frac{3}{4}$*d.* to the fraction of a guinea.

71. Reduce 9*s.* $11\frac{3}{7}$*d.* to the fraction of a moidore.

72. What part of 5*l.* 9*s.* is 4*l.* 13*s.* $5\frac{2}{9}$*d.*?

73. Reduce 8 oz. $14\frac{2}{9}$ drs. to the fraction of a pound avoirdupois.

74. What part of 10 cwt. 1 qr. 12 lbs. is 8 cwt. 1 qr. 25 lbs.?

75. Reduce 2 feet 3 inches to the fraction of a yard.

76. Reduce 343 yds. $2\frac{5}{6}$ ft. to the fraction of a mile.

77. What part of a pound is 3*s.* $10\frac{1}{2}$*d.*?

78. Reduce 7 gals. 3 qts. of wine to the fraction of a hhd.

79. What part of a tun of wine is 1 hhd. $59\frac{1}{7}$ gals.?

80. Reduce 2 roods 3 poles to the fraction of an acre.

81. Reduce 3 bls. 2 pks. $1\frac{1}{3}$ qt. to the fraction of a quarter.

82. Reduce 12 hrs. 48 min. to the fraction of a year.

83. Reduce 13 hrs. 30 min. to the fraction of a day.

Case X.—To reduce fractions of one denomination to fractions of another denomination, retaining the same value.

Rule 1.—When the reduction is from a *less* to a *greater* denomination, multiply the *denominator* by all the denominations between the one given and the one required.

Rule 2.—When the reduction is from a *greater* to a *less* denomination, multiply the *numerator* by all the *denominations* between the one given and the one sought, similar to the rule for reducing compound fractions to single ones, and reduce this fraction to its lowest terms for the answer.

Examples.

First, to reduce a *small* name to a greater—

84. Reduce $\frac{5}{7}$ of a farthing to the fraction of a pound.

$$\frac{5}{7}\times\frac{1}{4}\times\frac{1}{12}\times\frac{1}{20}=\frac{5}{6720}=\frac{1}{1344}\text{ pound} = \text{Answer.}$$

Second, to reduce a *great* name to a smaller—

85. Reduce $\frac{1}{1344}$ of a pound to the fraction of a farthing.

$$\frac{1}{1344}\times\frac{20}{1}\times\frac{12}{1}\times\frac{4}{1}=\frac{960}{1344}=\frac{5}{7} \text{ Answer.}$$

I have given you these two examples, by which you may see that one part of the Rule is the reverse of the other.

86. Reduce $\frac{4}{5}$ of a penny to the fraction of a pound.

87. Reduce $\frac{3}{10}$ of a pound to the fraction of a farthing.

88. Reduce $\frac{3}{11}$ of a guinea to the fraction of a penny.

89. Reduce $\frac{3}{58}$ of a pound to the fraction of a penny.

90. Reduce $\frac{2}{9}$ of a halfpenny to the fraction of a moidore.

91. Reduce $\frac{5}{8}$ of a lb. Troy to the fraction of a grain.

92. Reduce $\frac{2}{7}$ of an ounce avoirdupois to the fraction of a cwt.

93. Reduce $\frac{2}{3}$ of a gallon to the fraction of a hhd.

94. Reduce $\frac{3}{9}$ of a yard to the fraction of a mile.

95. Reduce $\frac{3}{5}$ of a sovereign to the fraction of a groat.

CASE XI.—To reduce fractions of different denominators, to others of a common denominator of the same value.

Rule.—Multiply each numerator into every denominator except its own, for a numerator, and all the denominators together for a new denominator; if any of the fractions require to be reduced first, do it by the former rules.

Examples.

96. Reduce $\frac{2}{3}$, $\frac{1}{5}$, $\frac{6}{10}$, and $\frac{5}{8}$ to a common denominator.

$$\left.\begin{array}{l} 2\times5\times10\times\ 8=\ 800 \\ 1\times3\times10\times\ 8=\ 240 \\ 6\times3\times\ 5\times\ 8=\ 720 \\ 5\times3\times\ 5\times10=\ 750 \end{array}\right\}\text{New Numerators.}$$

$$\overline{3\times5\times10\times\ 8=1200}\quad\text{Common denominator;}$$

$$\text{therefore, } \frac{2}{3}=\frac{800}{1200},\ \frac{1}{5}=\frac{240}{1200},\ \frac{6}{10}=\frac{720}{1200},\ \frac{5}{8}=\frac{750}{1200}.$$

97. Reduce $3\frac{1}{2}$, $\frac{5}{7}$, $\frac{6}{19}$, and $\frac{12}{37}$, to a common denominator.

98. Reduce $\frac{6}{10}$, $\frac{3}{9}$, $\frac{4}{7}$, and $\frac{2}{3}$, to a common denominator.

99. Reduce $\frac{4}{9}$, $\frac{7}{11}$, $\frac{6}{7}$, $\frac{1}{2}$, to a common denominator.

100. Reduce $\frac{3}{13}$, $\frac{5}{8}$, $\frac{6}{7}$, and $\frac{23}{61}$, to a common denominator.

101. Reduce $\frac{3}{19}$, $2\frac{1}{8}$, $4\frac{5}{9}$, and $3\frac{4}{16}$, to a common denominator.

CONSTANTIA.

Having finished all the cases in reduction, Lavinia, which are necessary to perform the rules that follow, I shall now proceed to—

ADDITION OF FRACTIONS,

which you will find extremely simple by a careful attention to the rules you have just finished.

Rule.—Reduce mixed numbers to improper fractions, compound and complex fractions to simple ones, and those that have different denominators to a common denominator, add together all the numerators, and place the *sum* of them above the common denominator, which is the sum of the fractions required.

Examples.

1. Add $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{4}{5}$, together.

$$\left.\begin{array}{r} 2\times4\times5=40\\ 3\times3\times5=45\\ 4\times3\times4=48\end{array}\right\}\text{ New numerators.}$$

$$\frac{\text{Sum } 133}{3\times4\times5=60} = 2\tfrac{13}{60}\text{ Answer.}$$

2. Add $\frac{5}{8}$, $\frac{7}{10}$, and $2\frac{1}{2}$, together.
3. Add $\frac{5}{6}$, 3, and $\frac{4}{9}$, together.
4. Add $5\frac{4}{5}$, $3\frac{7}{9}$, and $8\frac{6}{7}$, together.
5. Add $\frac{2}{3}$ of a shilling to $\frac{5}{9}$ of a pound.*
6. Add $\frac{3}{4}$ of $\frac{2}{9}$, $\frac{7}{12}$ of $\frac{4}{11}$, and $\frac{19}{23}$, together.
7. What is the sum of $\frac{5}{9}$ of a guinea, $\frac{4}{7}$ of a pound and $\frac{2}{3}$ of a shilling?
8. What is the sum of $\frac{3}{8}$ of 2*l.* 19*s.*, $\frac{4}{10}$ of 5 guineas, and $\frac{7}{9}$ of a moidore?

---

* To find the value of each fraction, you must reduce them to their proper terms by Case VIII.

9. What is the sum of $\frac{4}{9}$ of a lb. Troy, and $\frac{2}{5}$ of an ounce?

10. Add $\frac{3}{4}$ of a cwt. to $\frac{7}{11}$ of a lb. avoirdupois.

11. What is the sum of $\frac{5}{6}$ of $\frac{2}{3}$ of a hhd., and $\frac{3}{7}$ of $\frac{9}{11}$ of a gallon?

12. What is the sum of $\frac{2}{3}$ of 15 feet, and $\frac{3}{5}$ of $12\frac{1}{2}$ feet?

13. Add $\frac{1}{3}$ of a day to $\frac{1}{2}$ an hour.

14. Add $\frac{3}{4}$ of a mile to $\frac{7}{10}$ of a furlong.

15. Add $\frac{4}{9}$ of a chaldron to $\frac{7}{8}$ of a bushel.

16. Add $\frac{2}{3}$ of a mile, $\frac{5}{7}$ of a furlong, and $\frac{3}{11}$ of a yard, together.

LAVINIA.

I have finished the examples you gave me, and am prepared to enter another Rule.

CONSTANTIA.

Well, we will proceed to —

SUBTRACTION.

Rule. — As in the last Rule, reduce mixed numbers to improper fractions, complex and compound fractions to simple ones, and those of different denominations to a common denominator, the difference between the two numerators placed over the common denominator will be the fraction required.

Examples.

1. From $\frac{2}{3}$ take $\frac{5}{9}$.

$$\begin{array}{r}
\left.\begin{array}{r} 2\times9=18 \\ 5\times3=15 \end{array}\right\}\text{ New numerators.} \\
\overline{3} \\
\overline{}=\tfrac{1}{9}\text{ Answer.} \\
3\times9=27
\end{array}$$

2. From $\frac{5}{8}$ take $\frac{3}{7}$.
3. From 51 take $5\frac{1}{3}$.
4. From $7\frac{1}{2}$ take $\frac{17}{19}$.
5. From $\frac{1}{3}$ of 76 take $\frac{3}{4}$ of 21.
6. From $\frac{1}{2}$ of a guinea take $\frac{5}{11}$ of a pound.
7. From $\frac{1}{2}$ of a shilling take $\frac{3}{4}$ of a penny.
8. From $\frac{2}{3}$ of a league take $\frac{7}{10}$ of a mile.
9. From 1 E. ell take $\frac{5}{9}$ of a quarter.
10. What is the difference between $\dfrac{32}{7\frac{1}{3}}$ and $\dfrac{\frac{5}{8}}{17}$?
11. From $\frac{5}{6}$ of a lb. Troy take $\frac{5}{9}$ of an ounce.
12. From $\frac{2}{7}$ of $\frac{5}{6}$ of a hhd. take $\frac{4}{5}$ of a gallon.
13. What is the difference between $\frac{27}{419}$ and a unit?

MULTIPLICATION.

Rule. — Prepare all those fractions that require it by the rules for Reduction, then multiply all the numerators together for a new numerator, and all the denominators for a new denominator. The work may be considerably shortened by striking out numbers alike in the numerators and denominators, or by dividing by any number that will divide a numerator and denominator without a remainder, and use the quotients instead.

Examples.

1. Multiply $\frac{3}{4}$, $\frac{5}{9}$, and $\frac{4}{7}$ together.

$$\frac{\cancel{3}}{\cancel{4}} \times \frac{5}{\underset{3}{\cancel{9}}} \times \frac{\cancel{4}}{7} = \frac{5}{21} \text{ Answer.}$$

Here, you see, I strike out the 4 above and the 4 below, and divide the 9 by 3, and 3 by the same number, and use their *quotients* instead; because if you divide or multiply the numerator and denominator of a fraction by the same number, you do not change its value.

2. Multiply $\frac{3}{4}$ by $\frac{3}{11}$.
3. Multiply $7\frac{1}{4}$ by $8\frac{1}{2}$.
4. Multiply $3\frac{1}{2}$ by $2\frac{1}{2}$.
5. Multiply $\frac{1}{5}$ of 8 by $\frac{7}{8}$ of 5.
6. Multiply $\frac{7}{8}$ by $13\frac{3}{10}$.
7. Multiply $12\frac{3}{5}$ by $19\frac{6}{7}$.
8. What is the product of $\frac{119}{317}$ by 18?
9. How many square feet are contained in the Great Hall at Hampton Court, which measures about 106 feet long and $39\frac{3}{4}$ feet wide?
10. The three Cartoons exhibited in Westminster Hall which obtained the prize of 300 guineas each, measured as follows:—Cæsar's Invasion of Britain, by Armitage, 15 feet long by 10 feet $4\frac{1}{2}$ inches wide; Caractacus led in triumph through the streets of Rome, by Watts, 15 feet by 9 feet 9 inches; and the First Trial by Jury, by Cope,

15 feet by 10 feet; what number of superficial feet are contained in the three Cartoons?

11. What is the content of a drawing-room measuring $16\frac{1}{2}$ feet by $23\frac{3}{4}$ feet?

12. How many square feet are contained in a hall which measures $4\frac{3}{4}$ feet wide by $29\frac{1}{2}$ feet long?

DIVISION.

Rule. — Reduce mixed numbers, compound and complex fractions, to their proper terms by the foregoing rules; then *invert* your divisor, and proceed as in Multiplication.

LAVINIA.

But is it not strange to work Division by Multiplication?

CONSTANTIA.

This may appear so, Lavinia, to you; and I confess, to a beginner, it is difficult to understand without a clear explanation; but in the Multiplication of Fractions it does not follow that the number is always increased, for if you multiply a *proper* fraction by a *proper* fraction, the product will be *less* than the *multiplier* or the *multiplicand;* and if you multiply any whole or mixed number by a *proper fraction,* the product will be less than the multiplicand. I dare say you think this very strange; but suppose I cut an orange into 6 parts, and give you 3 of them, I should leave $\frac{3}{6}$ths. Now, if I multiply $\frac{3}{6}$ by $\frac{1}{5}$, it is $\frac{3}{30}$ths; therefore, though I increase the number of parts left in the orange, I make each part of less value, because I make my 6 parts into 30, and have $\frac{3}{30}$ths instead of $\frac{3}{6}$ths, or $\frac{1}{10}$th instead of $\frac{1}{2}$.

I will also illustrate this by multiplying a *whole number* by a *proper* fraction. Suppose you have 6 oranges, and you multiply them by $\frac{3}{4}$, it would stand thus: $\frac{6}{1} \times \frac{3}{4} = \frac{18}{4} = 4\frac{1}{2}$; here you see the 6 is changed into $4\frac{1}{2}$ by multiplying by the fraction $\frac{3}{4}$; on the other hand, if you divide a whole or mixed number by a proper fraction, the *quotient* will be *greater* than the *dividend*, thus $\frac{6}{1} \div \frac{3}{4} = \frac{6}{1} \times \frac{4}{3} = \frac{24}{3} = 8$, and it is quite clear that 8 times $\frac{3}{4} = 6$.

LAVINIA.

I could not comprehend this difficulty before.

Examples.

1. Divide $\frac{9}{11}$ by $\frac{2}{3}$.

$\frac{9}{11} \times \frac{3}{2} = \frac{27}{22} = 1\frac{5}{22}$ Answer.

2. Divide $1\frac{1}{2}$ by $4\frac{8}{10}$.
3. Divide $3\frac{2}{9}$ by $2\frac{8}{11}$.
4. Divide 108 by 96.
5. Divide $\frac{2}{3}$ of $\frac{4}{5}$ by $\frac{1}{6}$ of $7\frac{3}{4}$.
6. Divide $\frac{19}{20}$ by $17\frac{1}{3}$.
7. Divide $\frac{5}{16}$ of 8 by $9\frac{1}{2}$ of 3.
8. Divide $\frac{2}{17}$ of $\frac{6}{19}$ by 325.
9. Divide $\frac{5}{9}$ of 3 by $3\frac{5}{7}$.
10. Divide $\frac{8}{27}$ of $\frac{3}{5}$ of $5\frac{1}{2}$ by $102\frac{3}{7}$.

THE RULE OF THREE DIRECT IN VULGAR FRACTIONS.

CONSTANTIA.

I need not say any thing in this Rule, Lavinia, respecting the nature of Proportion, having sufficiently explained it in the Simple Rule of Three.

LAVINIA.

But is Proportion in Fractions the same as in Simple Proportion?

CONSTANTIA.

Precisely. The only difference is, that you have to prepare your sums by the following Rule: — Reduce mixed numbers, improper, compound, and complex fractions by Reduction, and your *first* and *third* terms to fractions of the same denomination, invert your *first* term, which is the *divisor*, and multiply the three terms together, both numerators and denominators, and the product will be the answer, in the same denomination as your *second* term.

Examples.

1. If $\frac{2}{3}$ of a yard cost $\frac{5}{9}$ of a pound, what will $\frac{7}{8}$ of an English ell cost?

First, $\frac{2}{3}$ of a yard $=\frac{2}{3}\times\frac{4}{5}=\frac{8}{15}$ of an ell.

Then, as $\overset{\text{ell.}}{\frac{8}{15}} : \overset{\text{£.}}{\frac{5}{9}} :: \overset{\text{ell.}}{\frac{7}{8}}$;

And, $\frac{15}{8}\times\frac{5}{9}\times\frac{7}{8}=\frac{525}{576}$ £ $=$ 18*s*. 2¾*d*. Answer.

2. If $\frac{3}{5}$ of a pound cost 8*s.* 6*d.*, what will $7\frac{2}{3}$ of a pound cost?

3. If a yard of cloth cost $15\frac{2}{3}$*s.*, what will 10 pieces each $29\frac{1}{2}$ yards cost?

4. What is the value of $\frac{3}{4}$ of an ounce of gold, if an ounce be worth 3*l.* 17*s.* 10*d.*?

5. If $9\frac{1}{2}$ pounds of tea cost $46\frac{5}{7}$*s.*, what will $\frac{3}{5}$ of $\frac{6}{7}$ of a cwt. cost?

6. What is the worth of 4 hhds. of sugar, each weighing 3 cwt. 1 qr. $17\frac{1}{5}$ lbs. at $8\frac{3}{4}$*d.* per lb.?

7. A person obtains $\frac{3}{16}$ of a lottery prize, and receives for it 132*l.* 12*s.* 6*d.*, what is the value of the whole prize at that rate?

8. A gentleman dying, left his children 1000 guineas each, and the residue of his estate, after payment of the legacies, amounted to 470*l.*, which he ordered to be distributed in the following manner: $\frac{2}{3}$ to his butler, $\frac{1}{4}$ of the remainder to his coachman, and the rest to his housekeeper; what had each to receive, and what sum did he bequeath, supposing there were five children?

INVERSE PROPORTION.

CONSTANTIA.

We now come to the Rule of Inverse Proportion, which is similar to the one in whole numbers. Reduce the fractions, if required, as in the last Rule, but instead of inverting the first term, *invert the third*, and multiply the three together, as in Multiplication of Fractions.

Examples.

1. If 12 men will do a piece of work in $17\frac{1}{8}$ days, how long will it take 10 men to perform the same?

First, $17\frac{1}{8}$ days $= \frac{137}{8}$ days.

Men. Days. Men.

Then, as $\frac{12}{1} : \frac{137}{8} :: \frac{10}{1}$

$$\text{And } \frac{\overset{3}{\cancel{12}}}{1} \times \frac{187}{\underset{2}{\cancel{8}}} \times \frac{1}{10} = \frac{411}{20} = 20\tfrac{11}{20} \text{ days — Answer.}$$

In this example, you see I have cancelled the 12 and 8, by dividing by 4, and using their quotients instead, which you will often find greatly shortens the work.

2. What quantity of matting $\frac{3}{4}$ wide will it take to cover a hall floor that measures $42\frac{1}{2}$ feet long and $3\frac{3}{4}$ feet wide?

3. If a person can perform a journey in $28\frac{3}{4}$ days, when the day is $14\frac{3}{4}$ hours long; how long will it take him when it is $12\frac{1}{2}$ hours long?

4. If $2\frac{1}{2}$ yards of cloth is sufficient for a garment when it is $1\frac{1}{2}$ yard wide, how much will it take when the cloth is $1\frac{1}{4}$ yard wide?

5. How many pieces of goods, at $20\frac{1}{3}$*s.* each piece, are worth 150 pieces at 12*s.* $9\frac{1}{3}$*d.* each?

6. How much shalloon $\frac{5}{8}$ of a yard wide will line $20\frac{1}{2}$ yards of cloth at $1\frac{1}{4}$ yard wide?

COMPOUND PROPORTION.

CONSTANTIA.

You will find, Lavinia, that the Rule for Compound Proportion in whole numbers is applicable to this, the only difference is, that you must reduce mixed numbers, compound and complex fractions, to their proper terms, and invert the terms which are made use of for the divisors, and multiply all the fractions together.

Examples.

1. What is the interest of 300 guineas for $7\frac{1}{2}$ years at $4\frac{1}{2}$ per cent. per annum?

First, $7\frac{1}{2}$ years $= \frac{15}{2}$ years $\quad 4\frac{1}{2}l. = \frac{9}{2}l.$

$$\text{Then}\left\{\text{as}\quad\begin{array}{ccccc} & \text{£} & & \text{£} & \text{£} \\ + & \frac{100}{1} & : & \frac{9}{2} & :: \frac{315}{1} \\ & & & & \\ + & \frac{1}{1} & : & — & :: \frac{15}{2} \end{array}\right.$$

$$\text{And } \frac{1}{\underset{4}{\underset{\cancel{20}}{\cancel{100}}}} \times \frac{1}{1} \times \frac{9}{2} \times \frac{\overset{63}{\cancel{315}}}{1} \times \frac{\overset{3}{\cancel{15}}}{2} = \frac{1701}{16} = \overset{\text{£}}{106}\ \overset{s.}{6}\ \overset{d.}{3} \text{ Ans.}$$

2. If a person travels 150 miles in $5\frac{1}{2}$ days when the day is $12\frac{1}{2}$ hours long, in how many days of $10\frac{1}{4}$ hours each can he travel $150\frac{5}{8}$ miles?

3. Three sailors having been abroad for $8\frac{1}{4}$ months received $50\frac{3}{4}l.$, how much must 100 sailors receive for $18\frac{3}{5}$ months' service?

4. A family of 5 persons usually drank $8\frac{3}{5}$ gallons of ale in a week, how much will this family consume in $17\frac{1}{3}$ weeks, if 5 more be added to the number?

5. A person bought 400 deals 21 feet long and $2\frac{1}{2}$ inches thick, how many deals, 15 feet long and $1\frac{3}{4}$ inch thick, are equal to that number?

6. What will the wages of 25 men come to for $15\frac{1}{4}$ days, if 10 men for $5\frac{1}{2}$ days receive $7\frac{4}{5}$*l.*?

Promiscuous Questions.

7. Suppose A can do a piece of work in $6\frac{1}{2}$ days; B can do it in $4\frac{1}{2}$ days, and C in $3\frac{1}{2}$ days; how many days will it take them to do it if you set them all to work together?

8. What number is that from which if $14\frac{5}{8}$ be deducted the remainder will be $47\frac{9}{16}$?

9. A gentleman bought 3 suits of clothes containing $7\frac{2}{3}$ yards each; the first suit cost 17*s.* per yard, the second $\frac{5}{6}$ of 17*s.*, and the third $\frac{3}{4}$ of 17*s.*; what did the whole cost him?

10. If $\frac{3}{8}$ of a ship be worth 4000 guineas, what is the whole worth?

CONVERSATION XXVI.

ON DECIMAL FRACTIONS.

CONSTANTIA.

WELL, Lavinia, we now come to another kind of Arithmetic, which is much used amongst all classes of scientific men, called Decimal Arithmetic, from *decem*, ten, and sometimes Decimal Fractions, or Decimals.

LAVINIA.

But is not the other kind of Arithmetic sufficient for general use?

CONSTANTIA.

It may be so: but calculations may be carried to much greater correctness by this Rule, than by Vulgar Fractions, which have a limit to their application that decimals have not. I will now show you, my dear, what a decimal is.

Decimals, as you see by their name, are numbered by tenths, and they differ from Vulgar

Fractions by not having the *denominator* written beneath, but it is always *understood;* and they are known by having a point before them on the left hand, thus ·5 ·25, are decimal fractions, equal to $\frac{5}{10}$, and $\frac{25}{100}$ called five-tenths, and twenty-five hundredths.

The *denominator* of a decimal fraction always consists of as many ciphers as there are figures in the decimals, with a 1 prefixed, thus:—

$$\cdot 5=\tfrac{5}{10};\ \cdot 05=\tfrac{5}{100};\ \cdot 005=\tfrac{5}{1000},\ \&c.$$

Ciphers on the *right* hand of decimals do not alter their value in the least, for ·5, ·500, ·5000, &c., are of the same value as $\frac{5}{10}$, $\frac{500}{1000}$, $\frac{5000}{10000}$, these are all equal to $\frac{1}{2}$, which I explained to you in Vulgar Fractions.

Ciphers on the *left* hand of decimals lessen their value in a tenfold proportion, thus:— ·5, ·05, ·005, &c. = $\frac{5}{10}$, $\frac{5}{100}$, $\frac{5}{1000}$, &c., and therefore ·05 is ten times less than ·5.

A *mixed number* consists of a whole number and a decimal, thus: 122·5 = 122$\frac{1}{2}$, and 325·75 = 325$\frac{3}{4}$.

The nature of decimals in general is, to suppose one *pound*, one *shilling*, one *yard*, &c., to be divided into *ten equal* parts, and every one of those parts into *ten* more equal parts, and so on without end.

LAVINIA.

I think I can see that this is a much more useful rule than fractions. Is this part of Arithmetic very ancient?

CONSTANTIA.

Not so much so as the Arabian method of Arithmetic; but decimals have been in use more than three hundred years; they were invented by one Purbach, born in a village of the same name in Austria; and from that time they have always been considered an essential part of Arithmetic; and Astronomers, Chemists, Engineers, and men of all classes in the scientific world make use of them in their calculations, as well as men engaged in the various offices for the collection of the public revenues.

There is one thing you must strictly attend to in this Rule, which, to a careless observer, may seem of no importance; that is, the *point* made use of to separate decimals from whole numbers; for to omit that, or place it where it ought not to be, would lead you into the greatest error.

I shall now proceed to explain to you how to perform

ADDITION OF DECIMALS.

RULE.—Place down all the numbers so that the decimal points stand under each other, that is, units under units, tens under tens, &c., remembering that the decimals increase tenfold to the *right* hand of the point, and whole numbers increase the same to the *left* hand of it. Add up the numbers as in common addition, and let the point in this sum be under those in the numbers added.

Examples.

1. Add into one sum 15·471, 1·191, 4·326, 74·35, ·645, ·0028.

15·471
1·191
4·326
74·35
·645
·0028
95·9858 Answer.

2. Add into one sum 17·39, 18·021, 6·302, 861·47, 2·1005, ·0016.

3. Add 47·4, 19·71, 416, 421·78, 1·327, together.

4. Add together 412·16, 712·109, 61·048, ·511384, ·01.

5. Add together 107·43, ·00102, 613·3, 125·87, 42·0163, ·09931.

SUBTRACTION OF DECIMALS.

Rule.—Place the less number beneath the greater, and the points under each other, so that the whole numbers are under whole numbers, subtract the same as in the simple rule, placing the point in the remainder immediately beneath the others.

Examples.

1. From 36·319 take 4·6176.

$$\begin{array}{r} 36\cdot319 \\ 4\cdot6176 \\ \hline 31\cdot7014 \end{array}\ \text{Answer.}$$

2. What is the difference between 67·415 and 31·015?

3. What is the difference between ·7056 and 3·49?

4. What is the difference between 1· and ·2876?

5. What is the difference between ·897659 and ·897265?

6. What is the difference between ·0016 and fifteen thousandth parts?

7. What is the difference between three hundred inches, and three hundred thousandth parts of an inch?

MULTIPLICATION OF DECIMALS.

RULE.—Multiply the same as in whole numbers, and point off in the product towards the *right* hand as many decimals as are found in the multiplier and multiplicand; if there are not so many places in the product, supply the number by prefixing ciphers to the left hand.

When you have to multiply any decimal by 10, 100, or 1000, &c., you have only to remove the decimal point so many places to the right hand as there are ciphers, thus, ·263 × 10 = 2·63, and 4·875 × 100 = 487·5.

In multiplying whole numbers by a pure decimal, the product is *less* than the multiplicand, the same as in fractions.

Examples.

1. Multiply 5·3158 by 4·365.

```
   5·3158
    4·365
  -------
   265790
  318948
 159474
212632
---------
23·2034670  Answer.
```

2. Multiply ·00312 by ·0185

```
   ·00312
    ·0185
   ------
     1560
    2496
    312
---------
·000057720  Answer.
```

3. Multiply ·612 by 4·12.
4. Multiply 37·9 by 46·5.
5. Multiply ·34168 by 1·13067.
6. Multiply ·00071 by 121.
7. Multiply ·04638 by ·000012.
8. Multiply ·83754 by 861·391.

DIVISION OF DECIMALS.

Rule.—Divide the same as in the Rule for whole numbers; and in the *quotient* point off as many figures for the decimal, as the *dividend* has *more* than the divisor; if the number in the quotient is not sufficient, place as many ciphers on the *left hand* as will make it so. If the number of decimals in the *divisor* is greater than in the dividend, place as many ciphers in the dividend as will make them *equal*, and the quotient will be whole numbers till all these decimals are used in the work; after this you may continue the work as long as you think proper by annexing a cipher to every remainder; but if you use a number of decimals in the divisor exceeding the dividend, the other part of the *quotient* will be decimals.

Examples.

1. Divide 19·4 by 37·5.

```
37·5 ) 19·40      (      ·5173 quotient
       18·75              37·5
       -----             -----
       ··650             25865
         375            36211
         ----          15519
         2750             125
         2625         --------
         ----         19·40000 Proof.
          1250
          1125
          ----
          ··125
```

In this example, the divisor is a greater number than the dividend, therefore I annex a cipher, and to continue the division I subjoin one to each remainder, making the number of decimals in the dividend *five*, while the divisor has but *one*; I therefore point off *four* places in the quotient, which is the answer

2. Divide 4·18 by ·1812.
3. Divide ·612812 by 7·21.
4. Divide 1 by 863.
5. Divide ·012181 by ·12.
6. Divide ·0001212 by ·018.

REDUCTION OF DECIMALS.

CONSTANTIA.

This Rule, like Reduction in Fractions, admits of a variety of forms.

Case I.—To reduce a vulgar fraction to a decimal of equal value.

Rule.—Divide the numerator of the fraction by the denominator, and the quotient will be the answer. You are to borrow ciphers in the dividend as in Division of Decimals. When the fractions are compound or mixed numbers, reduce them by the rules in Reduction of Vulgar Fractions before you convert them to decimals.

Examples.

1. Reduce $\frac{3}{25}$ to a decimal.

```
25) 30 (·12   Answer.
    25
    ——
    ·50
     50
     ——
     ··
```

2. Reduce $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$, to decimals.
3. Reduce $\frac{5}{8}$ to a decimal.
4. Reduce $\frac{6}{192}$ to a decimal.
5. Reduce $\frac{5}{28}$ to a decimal.
6. Reduce $\frac{11}{14}$ of $\frac{10}{15}$ to a decimal.
7. Reduce $\frac{4}{26}$ to a decimal.
8. Reduce $19\frac{1}{12}$ to a mixed decimal.
9. Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ to a decimal.

CASE II.—To reduce numbers of different denominations, such as coins, weights, measures, &c., to decimals.

Rule.—Reduce the given quantity to the lowest terms mentioned for a *dividend*, as in Case IX. in Reduction of Vulgar Fractions, and then the integer into the same denomination for a *divisor*; the *quotient* from this division will be the decimal required.

Or, write the given denominations under each other, from the lowest denomination to the highest, and reduce each name to the next higher, as in Simple Reduction.

Examples.

10. Reduce 12*s.* 6½*d.* to the decimal of a pound.

		s.	*d.*
	20	12	6½
	12	12	
	240	150	
	4	4	
Divisor	960	602	Dividend.

960) 602·(·62708 Answer.
5760
·2600
1920
·6800
6720
··8000
7680
·320

By the second Rule.

4)2·	Farthings.
12)6·5	Pence.
2,0)12·5416	Shillings.
·62708	Answer — as before.

You must observe, in dividing decimals, that when you have ciphers in the divisor, you remove the point as many places to the *left* hand in the quotient as there are ciphers in the divisor.

11. Reduce 8*s.* 7½*d.* to the decimal of a pound.

12. What decimal part of a pound is 19*s.* 3½ ⅘*d.*?

13. Reduce 10*s.* 9½*d.* to the decimal of a pound.

14. Reduce 3 farthings to the decimal of a pound.

15. Reduce 17½ grains to the decimal of a pound Troy.

16. Reduce 14 drms. to the decimal of a pound avoirdupois.

17. Reduce 3 cwt. 2 qrs. to the decimal of a ton.

18. Reduce $193\frac{1}{11}$ drms. to the decimal of a cwt. avoirdupois.

19. Reduce $4\frac{3}{4}$ inches to the decimal of a yard.

20. Reduce 2 cwt. 3 qrs. $17\frac{1}{9}$ lbs. to the decimal of a ton.

21. Reduce 1 qr. 19 lbs. to the decimal of a cwt.

22. Reduce 127 yds. $2\frac{1}{2}$ feet to the decimal of a mile.

23. Reduce 39 gls. 2 qts. 1 pt. to the decimal of a hhd.

24. Reduce 3 bush. 2 pks. 4 qts. to the decimal of a quarter.

25. Reduce 3 months 2 weeks 4 days to the decimal of a year of 365 days.

CASE III.—To find the value of a decimal when the *integer* is known.

Rule.—Multiply the given decimal by the parts contained in the next lower denomination, and point off as many decimals to the *right* hand in the product as are in the given decimal; then multiply the remaining decimals by the parts in the next lower denomination, and point off as many decimals as before; and proceed thus till you come to the lowest parts contained in the integer; the figures cut off on the left hand in each line will give the value of the decimal required.

Examples.

26. What is the value of ·8635 of a pound sterling?

$$\begin{array}{r} \cdot 8635 \\ 20 \\ \hline 17\cdot 2700 \\ 12 \\ \hline 3\cdot 2400 \end{array}\quad \textbf{Answer } 17s.\ 3d.\ \cdot 24$$

You must observe, in the above example, that the figures pointed off to the left hand are not multiplied.

27. What is the proper quantity of ·861 of a pound sterling?

28. What is the proper quantity of ·468 of a shilling?

29. What is the proper quantity of ·0125 of a lb. Troy?

30. What is the proper quantity of ·6184 of a cwt.?

31. What is the proper quantity of ·298 of a yard?

32. What is the proper quantity of ·712 of a furlong?

33. What is the proper quantity of ·4129 of an English ell?

34. Reduce ·725 of a cwt. to its proper quantity.

35. What is the sum of ·5 of a mile, and ·375 of a furlong?

36. What is the difference between ·8534 of a moidore and ·732 of a pound?

37. Reduce to its proper quantity ·5136 of a year of 365¼?

38. What is the proper quantity of ·004317 of a mile?

39. Reduce to its proper quantity ·375 of a ton, ·43 of a cwt., and ·915 of a quarter.

PROPORTION IN DECIMALS.

CONSTANTIA.

In this Rule, Lavinia, you have to proceed according to the rules laid down in Proportion of whole numbers. But take care first to reduce Vulgar Fractions to Decimals, and numbers of one denomination to decimals of another, where required.

Examples.

1. If 2·75 lbs. of tea cost 9*s.* 4½*d.*, what will 3¾ lbs. cost?

```
                      s. d.        £     lbs.   lbs.
First by Reduction    9  4½  =  ·46874   3¾  =  3·75
            lbs.                                lbs.
Then as     2·75    :    ·46874    ::           3·75
                          ·375
                        ------
                        234370
                       328118
                      140622
                     ---------
           2·75 )  1·7577650 (       ·63918
                   1·650                 20
                   -----           --------
                    ·1077          12·78360
                      825                12
                    -----          --------
                     ·2526          9·40320
                      2475                4
                     -----         --------
                      ··515         1·61280
                        275        ========
                       ----
                       2400
                       2200        Answer 12s. 9¼d.
                       ----
                       ·200
                       ====
```

LAVINIA.

You appear to multiply the same terms as in whole numbers, I see.

CONSTANTIA.

Precisely. The principal thing is to regard your points in multiplying and dividing, and your *quotient* is to be reduced to its proper terms by Case III. in Reduction. I shall only give you a few examples, as all the sums in Proportion of whole numbers and fractions, may be done by this Rule.

2. If 1·47 cwt. of sugar cost 3*l.* 12*s.* 6*d.*, what cost 11 cwt. 3 qrs. 10 lbs.?

3. If a grain of gold be worth 3·5*d.*, what is the value of 14·372 ounces?

4. A person bought 37·05 yards of cloth for 10½ guineas; how many yards can be bought for 100⅝ guineas at that rate?

5. A person gave 3*l.* 19*s.* 6⅝*d.* for a piece of cloth, and paid at the rate of 2*s.* 9½*d.* a yard; what quantity was in the piece?

6. At the burning of Thebes, Cambyses, King of the Medes and Persians, raked from the ashes 100 talents of gold, and 2,300 talents of silver; what was the value in our money, reckoning the talent of *silver* worth 343*l.* 15*s*, and the talent of *gold* worth 5475¼*l.*?

7. A merchant bought 436 yds. of cloth for 8·5*s.* per yard, and sold it again for 10*s.* 6·75*d.*; how much did he gain by the sale of it?

CONVERSATION XXVII.

ON DUO-DECIMALS.

CONSTANTIA.

THERE is another kind of decimals, Lavinia, that I must direct your attention to for a short time, which are called duo-decimals, from *duo* two, and *decem*, ten, and answers to the number 12. In this Rule, every inferior denomination is divided into 12 parts.

This rule is made use of by different kinds of tradesmen in building, painting, and repairing houses, &c., who commonly call it cross multiplication, because they multiply the dimensions cross ways.

LAVINIA.

But could they not multiply their work by the other decimals?

CONSTANTIA.

It could be done, my dear, but this is the Rule that is always used by artificers in measuring their work, though some of them have different kinds of computation, viz.:—painting, plastering, and paving by the *yard;* glazing by the *foot;* flooring, roofing, and tiling by the *square* of 100 feet; and bricklayers' work by the *square rod* of 272¼ feet; but they lay aside the ¼ in their calculations, and take the dimensions in feet, inches, and parts, which are sometimes represented as under:—

$12'$ or inches = 1 foot.
$12''$ or seconds = 1 inch or $1'$.
$12'''$ or thirds = 1 second or $1''$.
$12''''$ or fourths = 1 third or $1'''$.

To perform the work, observe the following

Rule.

Set down the dimensions one under the other, so that feet stand under feet, inches under inches, &c., then begin at the first number towards the *left* hand in the multiplier, and multiply it by the last number in the *top* line, and whatever is the product, put it down as you would if multiplying pence in Compound Multiplication; then multiply the next number towards the *left* hand in the top line, and put down the result as before: proceed thus till you have multiplied all the numbers in the upper line by the first number in the lower line. After this multiply the top line by the *second* towards the right hand in the *multiplier,* and proceed as before, not forgetting to place the *first* product in each line one place further to the right hand every time you commence multiplying a fresh line; and where a cipher or ciphers intervene in the *multiplier* remove the first figure of the product one place towards the right hand for each cipher.

Examples.

1. Multiply 9 feet 7 in. by 3 ft. 8 inches.

$$\begin{array}{rrrl}
\text{ft.} & \text{in.} & & \\
9 & 7 & & \\
3 & 8 & & \\
\hline
28 & 9 & & \\
6 & 4 & 8 & \\
\hline
35 & 1 & 8 & \text{Answer.} \\
\hline
\end{array}$$

2. Multiply 6 ft. 8 in. 3 pts. by 5 ft. 3 in. 6 pts.

$$\begin{array}{rrrrr}
\text{ft.} & \text{in.} & '' & & \\
6 & 8 & 3 & & \\
5 & 3 & 6 & & \\
\hline
33 & 5 & 3 & & \\
1 & 8 & 0 & 9 & \\
 & 3 & 4 & 1 & 6 \\
\hline
35 & 4 & 7'' & 10''' & 6'''' \\
\hline
\end{array}$$

3. Multiply 4 ft. 3 in. by 8 ft. 7 in.

4. Multiply 12 ft. 4 in. by 10 ft. 9 in.

5. Multiply 9 ft. 3 in. 7 pts. by 7 ft. 6 in. 5 pts.

6. Multiply 17 ft. 9 in. by 13 ft. 9 in.

CONVERSATION XXVIII.

ON INVOLUTION.

CONSTANTIA.

Good morning, Lavinia; our conversation this time must turn upon a fresh Rule, which is called Involution.

LAVINIA.

I cannot say that I have any knowledge of this Rule.

CONSTANTIA.

That is likely: but I will soon show you that it is very easy to understand. Involution is simply multiplying any number by itself, and that product by the same number as far as you please.

The number so multiplied is called the *root* or *first* power; and the first power multiplied into itself gives the *second* power or square; the second power multiplied by the first gives the *third* or *cube;* and the third power multiplied by the *first* gives the fourth power or biquadrate, &c.

When a number is to be raised to a certain power, it has frequently a small figure over it called the index, or exponent, thus: 4^2 denotes the square of 4; 4^3 the cube of 4; and 4^4 the fourth power of 4, &c.; the following table will show you the ninth power of the first nine figures: —

A TABLE OF POWERS.

1st.	2d.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.
1	1	1	1	1	1	1	1	1
2	4	8	16	32	64	128	256	512
3	9	27	81	243	729	2187	6561	19683
4	16	64	256	1024	4096	16384	65536	262144
5	25	125	625	3125	15625	78125	390625	1953125
6	36	216	1296	7776	46656	279936	1679616	10077696
7	49	343	2401	16807	117649	823543	5764801	40353607
8	64	512	4096	32768	262144	2097152	16777216	134217728
9	81	729	6561	59049	531441	4782969	43046721	387420489

In multiplying a power any number of times, your number of multiplications must be one less than the index denotes; for instance, the fourth power of 5 is $5 \times 5 \times 5 \times 5 = 625$, because you reckon the first multiplicand as 1 power.

There are some properties in numbers that I may as well explain to you, under this Rule. The *multiplication* of powers answers to the *addition* of the indices, as you may see by the following powers of the number 2, which are carried as high as 10: —

1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.
2	4	8	16	32	64	128	256	512	1024.

Or thus,

2^1 2^2 2^3 2^4 2^5 2^6 2^7 2^8 2^9 2^{10}

Now, if you add any two or more of the indices above, their sum will point out the index of that power which you would obtain by multiplying those other powers together. Suppose you require to find the 7th power of 2, add the indices 4 and 3 together, which make 7; above it you have 128; if you multiply the powers under the indices 4 and 3, you have the same number.

Thus,

$$\begin{array}{r} 16 \\ 8 \\ \hline 128 \end{array}$$

Here, you see, Lavinia, that for any power of the number 2, you add such indices together as will make the number, and then multiply the numbers standing below those indices.

LAVINIA.

This appears very useful; but does it shorten the work?

CONSTANTIA.

Very much so; let us find the 7th power of 2 by multiplication, and it will stand thus: —

$$\begin{array}{rl}
2 & \text{1st power.} \\
2 & \\ \hline
4 & \text{2nd power or square.} \\
2 & \\ \hline
8 & \text{3rd power or cube.} \\
2 & \\ \hline
16 & \text{4th power.} \\
2 & \\ \hline
32 & \text{5th power.} \\
2 & \\ \hline
64 & \text{6th power.} \\
2 & \\ \hline
128 & \text{7th power.} \\ \hline
\end{array}$$

By the first method the work contains 6 figures, by the second 18.

Examples.

1. What is the square of 1326?
2. Cube 2436.
3. What is the cube of 34·125?
4. What is the 4th power of 193219?
5. What is the 5th power of ·615?
6. What is the 9th power of 26·102?
7. What is the 7th power of 2163?
8. Involve 319·5 to the 8th power.
9. Involve 618 to the 14th power.
10. What is the 20th power of 127?

CONVERSATION XXIX.

ON EVOLUTION.

CONSTANTIA.

THE Rule we have before us, Lavinia, to-day, is called Evolution, because it evolves, or unfolds certain numbers which were *in*volved by the last Rule; and it is sometimes called the Extracting of Roots.

LAVINIA.

Then by this Rule, I suppose I can find out the root of any of the numbers in the last Rule.

CONSTANTIA.

Not *exactly* so: there are some numbers that have not an exact root, and though you can have any number to a certain power, you will find many numbers have not precise roots, but by means of decimals you can approach near to the root to very great exactness.

The roots which cannot be found exactly, are called *surd* roots; but those which are exact, are called *rational* roots; for instance, the square root of 26 is a surd, but the square root of 25, which is 5, is a *rational* root. The signs made use of to denote the square root are these, $\sqrt{16}$, or $(16)^{\frac{1}{2}}$; and the square root of $19-17$ by $\sqrt{19+17}$, or $(19+17)^{\frac{1}{2}}$. This Rule, Lavinia, comprises various forms, which I shall arrange separately.

Case I. — To extract the square root of a whole number or decimal.

Rule.—Point off the given number into periods of *two* figures, beginning at the unit's place. Find the greatest *square* in the first period towards the *left* hand, and set its root on the *right* hand, similar to the quotient of a Division sum.

Subtract this square from the period above it, and to the remainder bring down the next period of two figures for a *dividend.*

Double the above-named root for a divisor, and see how often it is contained in the dividend without the unit's figure, and put it both in the unit's place of the *divisor* and in the *quotient.*

Multiply this divisor by the last figure in the quotient, and subtract the product from the dividend, and to the remainder bring down the next period of figures for a new dividend.

Pursue the same plan again by doubling all the figures in the quotient for a new divisor, see how many times it will go in the last dividend, and place the number in the divisor, and in the quotient, and proceed the same as before.

Take care to observe, in pointing off the figures in the given number, to begin at the unit's place, and point off *whole* numbers to the *left* hand, and decimals to the *right;* and where you have only one figure to bring down from the given number, annex a cipher.

Proof.— *Square* the figures in the root, and add the remainder, if any, to that product; this sum will equal the given number.

Examples.

1. What is the square root of 207936?

	20̇79̇36̇	(	456	Root — Answer.
Divisor	16		456	
4 × 2 = 8-5)	479	dividend	2736	
	425		2280	
			1824	
45 × 2 = 90-6)	5436			
	5436		207936	Proof.
	....			

2. What is the square root of 17·3056?

	17̇·30̇56̇	(	4·16	Root.
	16		4·16	
4 × 2 = 18-1)	130		2496	
	81		416	
			1664	
41 × 2 = 82-6)	4956			
	4956		17·3056	Proof.
	....			

3. What is the square root of 185·3204?

```
                       ·  ·  ·  ·
                       185·3204    (     13·61  Root.
                       1                 13·61
                       ───               ─────
        1 × 2 = 2-3 ) ·85                 1361
                        69               8166
                        ───             4083
      13 × 2 = 26-6 ) 1632             1361
                      1596                 883
                      ────             ────────
    136 × 2 = 272-1) ··3604            185·3204  Proof.
                        2721           ────────
                        ·883
                        ────
```

These examples, Lavinia, are sufficient to show the nature of the different parts of this rule. I have made a little mark to show you the figure which is placed in the *divisor*, and in the *quotient*, which is always placed on the *right* hand of the divisor. The remainder must be added in the proof like *whole numbers*.

4. What is the square root of 133225?
5. What is the square root of 9409?
6. What is the square root of 851822596?
7. What is the square root of 2640·520996?
8. What is the square root of 31·008365?
9. What is the square root of 195·3105?
10. What is the square root of 3?*
11. What is the square root of 7?
12. What is the square root of 12?

CASE II. — To extract the square root of a vulgar fraction.

---

* In these examples it is sufficient to carry them out to five decimal places.

Rule. — Reduce the given fraction to its lowest terms; then extract the square root of the numerator, for a new numerator, and the square root of the denominator for a new denominator.

If the fraction should not have an *even* root, reduce it to a decimal, and then extract the square root.

If you have a *mixed number* to extract, reduce the *fractional part* to a decimal, and annex it to the whole number, then extract the square root.

Example.

13. What is the square root of $\frac{25}{36}$?

$$\frac{\sqrt{25}}{36} = \frac{5}{6} \quad \text{Answer.}$$

There is another way of performing this Rule, viz., by multiplying the numerator and denominator together, and extracting the square root of that product, and then placing the given denominator beneath this root, and reducing the fraction to its lowest terms; if the numerator and denominator, after being multiplied together, do not extract *even*, annex ciphers as necessary, and divide the root thus obtained by the given denominator for the true root. Or, you may reduce the fraction to a decimal, and then extract the square root, thus:

Examples.

14. What is the square root of $\frac{25}{36}$?

```
 36
 25
———
180
72
———
900 ( 30 Root.
9     ——
———   36 Given denominator.
·00
———
```

And $\frac{30}{36} = \frac{5}{6}$ Answer as before.

LAVINIA.

This Rule appears very easy after having learned fractions correctly.

15. What is the square root of $\frac{5}{12}$?

```
           12
            5
           ——
           60 ( 12 ) ·7745966
           49        ————————
           ———        ·645497 Root required.
     147 ) 1100       ———————
           1029
           ————
    1544 ) ··7100
             6176
             —————
   15485 ) ·92400
             77425
             ——————
  154909 ) 1497500
           1394181
           ————————
 1549186 ) ·10331900
             9295116
             —————————
15491926 )  103678400
             92951556
             —————————
             10726844
             ————————
```

16. What is the square root of $\frac{7056}{9216}$?
17. What is the square root of $\frac{27}{147}$?
18. What is the square root of $37\frac{36}{49}$?
19. What is the square root of $7\frac{9}{11}$?
20. What is the square root of $5\frac{1}{9}$?
21. What is the square root of $\frac{15}{19}$?
22. What is the square root $81\frac{7}{11}$?

Case III. — To find a mean proportional or middle number between two given numbers, which is one of the applications of the square root.

Rule. — Multiply the two given numbers together, and extract the square root of the product.

Examples.

23. What is the mean proportional between 3 and 12?

$$\text{First}\quad \begin{array}{r} 12 \\ 3 \\ \hline 36 \\ \hline \end{array}$$

$$\text{And } \sqrt{36} = 6 \text{ Answer.}$$

24. What is the mean proportional between 4 and 25?

25. What is the mean proportional between 18 and 32?

Case IV. — To find the *side* of a square, equal in its contents or area, to any given *superficial* quantity.

This case, Lavinia, requires some little explanation; and it is intended to show you how long a line must be, which if squared (see page 59.) or multiplied into itself, will produce the given quantity. Suppose your Papa has a piece of waste ground of an *irregular* shape, which he wishes to cultivate and make into a kitchen garden, perfectly square, and walled in on each side; by this rule he can easily find out what length he must build his wall, so as to contain the required quantity of ground.

Rule. — Extract the square root of the given quantity, whether it be in yards, feet, or inches, and it will be the side of a square of the same measure as the given quantity, in yards or feet, &c.

Examples.

26. A gentleman has a piece of ground which measures 3 acres, 2 roods, 15 poles, and he wishes to convert the same quantity into a square piece to plant trees upon; how many yards must the side of a square measure that will contain the same quantity?

```
           A.  R. Pls.
           3   2   1
           4
          ---
          14
           40
          ----
          575
            30¼ = 1 pole.
         -------
         17250
           143·75
          ---------
          ·  ·  ·  ·
         17393·75 ( 131·88 yards.   Answer.
         1
        ---
  23 ) ·73
        69
       ----
 261 ) ·493
        261
       -----
2628 ) 23275
        21024
       -------
26368 ) ·225100
          200944
          ------
          ··4156
          ======
```

27. A number of men amounting to 222,784, are to be placed into a square; how many soldiers will form the front, or one side?

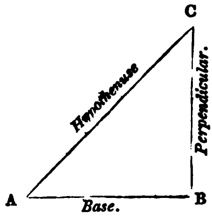
28. A piece of ground in the form of a circle contains 139·75 acres; what length is the side of a square that will contain the same number of acres?

29. A court yard contains 197,136 bricks, each a foot square; how many are contained in one of its sides?

30. How long is the side of a square room, that contains 5625 feet?

Case V. — To find the *third* line of a right-angled triangle, when *two* are given.

By a right-angled triangle is meant, a triangle that has one side standing exactly upright upon another, as in the following figure: —



in which the line A B, is the *base;* A C, the *hypothenuse,* or longest side; and B C, the *perpendicular.* Now, if the *perpendicular* is given, and the *base,* to find the *hypothenuse*—

Rule 1. — Add the *square* of the *base* to the *square* of the *perpendicular,* and the square root of the sum will be the hypothenuse.

Rule 2. — When the *hypothenuse* and *one* of the other sides are given, add the two sides together, and multiply this sum by their *difference,* and the square root of the product will give the *third* side.

LAVINIA.

But what is the use of this Rule?

CONSTANTIA.

Its uses, Lavinia, are very extensive, and particularly in ascertaining heights and distances, which are often unapproachable; and persons engaged in many of the professions of life, find this Rule of the greatest assistance; and if they can find the third side by only measuring two sides, it frequently saves them much labour and trouble.

Examples.

31. If the perpendicular of a right-angled triangle be 35 feet, and the base 25 feet, what is the length of the hypothenuse?

35 25
35 25
175 125
105 50
1225 square of perpendicular. 625 square of base.

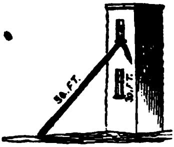
1225 } sum of the squares.
625
1850 (43·011 feet. Answer.
16
83) 250
249
8601) ··10000
8601
86021) 139900
86021
·53879

32. The hypothenuse of a right-angled triangle, A C, equals 30 feet, and the base, A B, 24 feet; what will be the height of the perpendicular, B C?

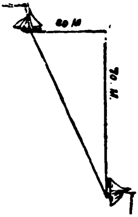
30 30
24 24
54 sum of sides. 6 difference of sides.

54
6
324 (18 feet perpendicular. Answer.
1
28) 224
224
···

33. A ladder 50 feet long is placed against a window 30 feet high, what distance is the foot of the ladder from the wall?



34. Two ships sail from the same port, one due-west 30 miles, and the other due-south 70 miles, how far are they apart?



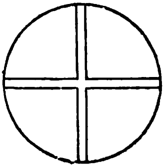
35. The Monument of London is 202 feet high from the ground to the top; how long must a cord be to reach from its summit to the distance of 150 feet from the foot of the building?

Case VI. — The area or surface of any circle being given to find the diameter.

Rule. — Divide the diameter by ·7854, and extract the square root of the quotient for the answer.

Examples.

36. A gentleman has a circular garden, enclosed by a wall, which contains just one acre, divided into 4 equal parts by gravel walks meeting in the centre, how long is each walk from the centre of the garden to the wall?



37. How long must a cord be to allow a horse to feed on one acre of grass, if fastened to a post in the centre?

Questions for Exercise.

38. The city of Babylon was a square, and had a certain number of gates made of solid brass, and an equal number on each side: there were streets from the gates on one side to those opposite, all at right angles, which divided the city into 625 squares. How many gates were on each side of the city? and how many in all?

39. St. Paul's cathedral stands on an area of 6 acres; what is the side of a square containing the same quantity of ground?

40. A gentleman had a garden surrounded by a wall, on one side of which there was a river, over which he purposed to build a foot-bridge; the wall was 14 feet high, and the distance from the top to the river's edge was 20 feet; what was the breadth of the river?

41. The largest of the Egyptian pyramids is about 500 feet high, and stands upon 480,249 square feet of ground; what is the length of one side of the base?

42. A society collected for charitable purposes 73*l.* 14*s.* 9*d.*, and each member contributed as many pence as there were members in the society; how much did each contribute?

43. A gentleman has a piece of ground containing 2 acres, which he wishes to form into a pleasure ground, and to have a gravel walk round it 4 feet wide; what length must the cords be to describe the two circles?

44. The wall of a town, which is surrounded by a moat 24 feet wide, is 18 feet high; what height must a ladder be made to reach from the outer edge of the moat to the top of the wall?

45. An irregular piece of ground consisting of 420 acres, 3 roods, 14 perches, is to be exchanged for a square piece of the same surface; what will be the length of one of its sides? this square is also to be divided into 4 equal squares; what will be the extent of a side of each?

CONVERSATION XXX.

ON CUBE ROOT.

CONSTANTIA.

OUR next step, Lavinia, is to say something of Cube Root. The nature of a cube I have already explained to you (see p. 60.); and to find the cube root is to find the dimensions of the side of a cube.

Rule 1.—Having pointed off the given number into periods of *three* figures each from the unit's place, find the nearest cube to the first period; put its root in the quotient, and subtract the cube from the first period; to the remainder bring down the next period, and call this the *dividend.*

Rule 2.—Find a *divisor* by multiplying the square of the quotient by 3, and see how often it is contained in the dividend, rejecting units and tens, and put the numbers in the quotient.

Rule 3.—To find the *subtrahend.*—1. Cube the last figure in the quotient. 2. Multiply all the figures in the quotient by 3, except the *last,* and that product by the *square* of the *last.* 3. Multiply the divisor by the last figure, add together all these products, and you will obtain the subtrahend, which subtract from the dividend; to the remainder bring down the next period, and proceed in the same manner till you have finished every period.

Proof.—Cube the root, and add in the remainder.

Examples.

1. What is the cube root of 44361864?

$$\begin{array}{rll}
 & \dot{4}436\dot{1}86\dot{4} & (\ 354\ \text{Root.} \\
 & \underline{27 = 3^3} & \\
\text{Divisor} & & \\
3^2 \times 3 = 27\ ) & \underline{17361} & \text{Dividend.} \\
 & 125 = 5^3 & \\
 & 225 = 3 \times 3 \times 5^2 & \\
 & \underline{135 = 27 \times 5} & \\
\text{Divisor} & & \\
35^2 \times 3 = 3675\ ) & \underline{15875} & \text{Subtrahend.} \\
 & \underline{1486864} & \text{Dividend.} \\
 & 64 = 4^3 & \\
 & 1680 = 35 \times 3 & \\
 & \underline{14700 = 3675 \times 4} & \\
 & \underline{1486864} & \text{Subtrahend.} \\
 & \underline{\underline{\cdots\cdots\cdot}} &
\end{array}$$

When the *subtrahend* is greater than the *dividend*, the figure in the root is too great; if *equal* to it, the root is an *even* one.

In pointing off your decimals, begin at the unit's place, and divide them into periods of three figures each for the cube root, four for the fourth root, &c.

2. What is the cube root of 148877?
3. What is the cube root of 46656?
4. What is the cube root of 389017?
5. What is the cube root of 20796875?
6. What is the cube root of 122615327232?
7. What is the cube root of ·7854?
8. What is the cube root of 75·3857?
9. What is the cube root of 517·375475?

TO EXTRACT THE CUBE ROOT OF A VULGAR FRACTION.

Rule.—Reduce the fraction to its lowest terms, and extract the cube root of the numerator and denominator for the fraction required.

If the fraction be a *surd,* reduce it to a decimal and extract the cube root.

When the number is a mixed one, reduce the fractional part to its lowest terms; and then make the mixed number an *improper* fraction, and extract the cube root of the numerator and denominator; but if the mixed number be a *surd,* reduce the *fractional* part to a decimal, annex it to the whole number, and extract the cube root.

Examples.

10. What is the cube root of $\frac{352}{1188}$?
11. What is the cube root of $\frac{324}{1500}$?
12. What is the cube root of $\frac{1944}{4608}$?

SURDS.

13. What is the cube root of $\frac{2}{3}$?
14. What is the cube root of $\frac{23}{24}$?
15. What is the cube root of $\frac{5}{9}$?

MIXED NUMBERS.

16. What is the cube root of $42\frac{21}{24}$?
17. What is the cube root of $5\frac{104}{125}$?
18. What is the cube root of $578\frac{19}{27}$?

SURDS.

19. What is the cube root of $7\frac{3}{5}$?
20. What is the cube root of $9\frac{3}{5}$?
21. What is the cube root of $6\frac{5}{7}$?

Rule 2nd.

TO EXTRACT ANY ROOT OF A GIVEN POWER.

1.—Point off the given number into periods from the unit's place according to the root you require, viz., 2 for the square root, 3 for the cube root, 4 for the fourth root, &c.

2.—Find the nearest root to the first period by your Table of Powers, page 280., and subtract its power from this given period.

3.—Bring down the *first* figure in the next period to the remainder, and call it the *dividend.*

4.—Involve this root into the next *lower* power than the given one (that is, if the given power is a *cube*, involve it to the *square* only), multiply it by the given power, and consider it the *divisor.*

5.—Then find the next *quotient* figure by common division, and join it to the root; and involve the *whole* root thus found into the *given* power for the *subtrahend.*

6.—Subtract the subtrahend from as many periods of the given number as you have made use of, beginning at the lowest place; and to the remainder, bring down the next figure for a new *dividend.* For a new divisor, &c., proceed as before.

Examples.

22. What is the cube root of 195112?

$19\dot{5}11\dot{2}$ (58 Root required.
$5^3 = 125$
Div. $5^2 \times 3 = 75$) ·701 Dividend.
$58^3 =$ 195112 Subtrahend.
......

23. What is the fourth root of 32015587041?

$32\dot{0}155\dot{8}704\dot{1}$ (423 Root required.
$4^4 = 256$
1st Divisor $4^3 \times 4 = 256$) ·641 1st Dividend.
$42^4 =$ 3111696 Subtrahend.
2d Div. $42^3 \times 4 = 296352$) 898627 2nd Dividend.
$423^4 =$ 32015587041 Subtrahend.
....

24. What is the square root of 952576?
25. What is the cube root of 22188041?
26. What is the fourth root of 4293967296?
27. What is the fifth root of 3?

Questions for Exercise.

28. A block of stone of a cubic form contains

18821096 solid inches; what is the length of one of its sides?

29. What quantity of solid earth can be dug from a cellar which measures 35 feet each way?

30. Pompey's Pillar, at Alexandria, has a cubical block of marble for its base, containing 3375 solid feet; what is the length of one of its sides?

31. If a cubical piece of timber be 59 inches long, 59 inches broad, and 59 inches deep, what number of solid inches is contained in it?

CONVERSATION XXXI.

ON SIMPLE INTEREST.

CONSTANTIA.

WE have now passed through all the most difficult Rules, Lavinia, and I think you will not be sorry for the change.

LAVINIA.

I must confess, I shall not; for although you have taken much trouble to remove all difficulties, or considerably lessen them, I do not like to have them last too long.

CONSTANTIA.

Well, our present conversations must turn upon SIMPLE INTEREST.

Interest is a term used amongst men of business, to denote the sum of money paid for the use of another sum lent for a definite or an indefinite period of time. It is also applied to insurance against fire or losses of different kinds, brokerage, commissions, purchasing stocks, &c.

The money thus lent is called the PRINCIPAL.

The money paid for its use is called INTEREST.

The principal and interest added together, is called the AMOUNT.

The RATE PER CENT. PER ANNUM, is the money paid as interest for 100*l.* for twelve months.

To find the interest of any sum of money for one year, or number of years.

Rule.—Multiply the *principal* by the rate per cent., and divide by 100, it will give the interest required; and multiply the interest of one year by the number of years. For $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, per cent., take $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$, of the principal before dividing by 100.

Examples.

1. What is the interest of 250*l.* 12*s.* for 1 year, at 5 per cent. per annum?

```
       £   s.
      250  12
            5
  ------------
  12,| 53   0
        20
   ---------
   10,| 60
        12
   ---------
    7,| 20
```

You will observe, instead of dividing by 100, *two* figures are cut off to the *right* hand in each denomination, and every remainder reduced to its next lower name.

2. What is the interest of 300 guineas for 3 years, at $4\frac{1}{2}$ per cent. per annum?

3. What is the interest of 493*l.* 16*s.* 4*d.* for 4½ years, at 3½ per cent. per annum?

4. What is the interest of 745*l.* 18*s.* 9*d.* for 7¾ years, at 2¾ per cent. per annum?

5. What is the interest of 500 guineas for 9¼ years, at 4¾ per cent. per annum?

6. If a factor be allowed 2½ per cent. commission, what is his demand if he lays out 850*l.* 12*s.*?

7. If I buy India stock at 123⅝ per cent., what is the purchase of 854*l.* 13*s.* 10*d.*?*

When the interest is for any number of weeks.

Rule.—By the Rule of Three, say, as 52 weeks are to the interest of the given sum for one year, so are the weeks given, to the interest required.

Examples.

8. What is the interest of 286*l.* 12*s.* 6*d.* for 25 weeks, at 5 per cent. per annum?

9. What is the interest of 319*l.* 16*s.* 5*d.* for 39 weeks, at 4½ per cent. per annum?

When the interest is for any number of days.

Rule.—As 365 days are to the interest of the given sum for 1 year, so are the days given to the interest required.

---

* Purchasing stock is a term used amongst Merchants who trade in the public funds, of which there are many kinds. When any stock is worth more than 100 per cent. it is called "*above par;*" when stock is sold at 100 per cent, it is said to be "*at par.*"

Examples.

10. What is the interest of 2149*l.* 10*s.* 3*d.* for 3 years 179 days, at 3¾ per cent. per annum?

11. What is the interest of 387*l.* 15*s.* 11*d.* for 5 years 284 days, at 4 per cent. per annum?

When the amount, time, and rate per cent. are given, to find the *principal.*

Rule.—As the *amount* of 100*l.* at the rate and time given is to 100*l.*, so is the amount given to the principal required.

Examples.

12. What principal put to interest will amount to 520*l.* in 3 years, at 3½ per cent. per annum?

£	*s.*	
3	10	Interest of 100*l.* for 1 year.
	3	Time.
10	10	Interest of 100*l.* for 3 years.
100	0	
110	10	Amount of 100*l.* at 3½ per cent. for 3 years.

£ s. £ £
Then as, 110 10 : 100 :: 520
20 10400 20
2210 40000 10400
1000
221,0) 104000,0 (470l. 11s. 9d. Answer.
884
·1560
1547
··130
20
221) 2600 (11
221
·390
221
169
12
221) 2028 (9
1989
··39

13. What principal put to interest for 3½ years will amount to 490l. 13s., at 4½ per cent. per annum?

14. What principal put to interest for 9 years will amount to 100l., at 5 per cent. per annum?

When the principal rate per cent., and the amount, are given to find the *time*.

Rule.—As the interest of the principal for 1 year, is to 1 year, so is the whole interest to the time required.

15. In what time will 500l. amount to 725l. at 5 per cent. per annum?

£ £
500 725 Amount.
5 500 Principal.
Interest for 1 yr. 25,00 225 Whole interest.

£ yr. £ yrs.
Then as 25 : 1 :: 225 : 9 Answer.

x 2

16. In what time will 620*l.* amount to 793*l.* 12*s.*, at 4 per cent. per annum?

When the principal amount and time are given to find the rate per *cent.*

Rule.—As the principal is to the interest for the *whole time*, so is 100*l.* to the interest of the same time; divide that interest by the given time for the answer.

17. At what rate of interest per cent. will 500*l.* amount to 725*l.* in 9 years?

£ £ £
As 500 : 225 :: 100
100
5,00) 225,00
9) 45
5 per cent. Answer.

18. At what rate per cent. will 620*l.* amount to 793*l.* 12*s.* in 7 years?

BROKERAGE

Is an allowance made to brokers for assisting merchants or other persons to buy or sell their goods.

Rule.—Divide the given sum by 100, and take parts from the quotient with the rate per cent. by Practice.

Example.

19. What is the demand of a broker, who sells goods to the value of 965l. 10s., at 5s. per cent.?

£ s.
9,65 10
20

13,10 5*s.* = ¼) 9 13 1
12

£2 8 3¼ Answer.

1,20

20. What will be the demand of a broker, who sells goods to the amount of 1949*l.* 18*s.* 5*d.*, at 4*s.* 6*d.* per cent.?

21. What is the brokerage of 3759*l.* 17*s.* 6*d.*, at 19*s.* 9¾*d.* per cent.?

22. When a broker sells goods to the amount of 7134*l.* 15*s.* 10*d.*, what will his brokerage amount to at 5*s.* 9*d.* per cent.?

CONVERSATION XXXII.

ON COMPOUND INTEREST.

CONSTANTIA.

COMPOUND INTEREST, Lavinia, is interest upon interest. Suppose I lend you 100*l.* for 12 months, at 5 per cent. per annum, and at the end of 12 months, I tell you I do not want it, if you agree to pay me interest upon all that is then due, which of course would be 105*l.*; your second year's interest to pay me would be upon 105*l.* instead of 100*l.*

RULE.—Find the interest for one year, and add to the principal; then find the interest of that sum, which add, as before, and proceed thus for any number of years.

Or, you may divide the principal by the aliquot part of 100, as in Practice, and add each year's interest to the former amount. If the time consists of months, weeks, &c., take aliquot parts accordingly.

Examples.

1. What is the compound *interest* of 450*l.* for 3 years, at 5 per cent. per annum?

£	£	s.	d.	
5 = $\frac{1}{20}$)	450	0	0	Principal.
	22	10	0	1st year's interest.
5 = $\frac{1}{20}$)	472	10	0	1st year's amount.
	23	12	6	2nd year's interest.
5 = $\frac{1}{20}$)	496	2	6	2nd year's amount.
	24	16	1½	3rd year's interest.
	520	18	7½	3rd year's amount.
	450	0	0	Principal.
Answer,	70	18	7½	Whole interest.

2. What is the compound *interest* of 530*l.* 10*s.* 9*d.* for 5 years, at 4 per cent. per annum?

3. What will 400*l.* *amount* to in 4 years, compound interest, at 6 per cent. per annum?

4. What is the compound *interest* of 628*l.* for 6 years, at 4½ per cent. per annum?

5. What is the *amount* of 900 guineas at compound interest for 5 years, at 4 per cent. per annum?

CONVERSATION XXXIII.

ON DISCOUNT, OR REBATE.

CONSTANTIA.

The Rule that is to be the subject of our conversation this morning, is called Discount, or Rebate; which is an allowance made for paying money before it is due, so that if the sum paid were put out to interest for the time, and at the rate for which the discount is made, it would amount to the debt when due.

LAVINIA.

Then I suppose it is like Interest?

CONSTANTIA.

Not quite so: the *interest* of 100*l.* is something *added* to it; but the *discount* is something *taken away*. For instance, the interest of 100*l.* for 12 months at 5 per cent., is *5l.*; but the *discount* of 100*l.* due 12 months hence, at *5l.* per cent. per annum, is *4l.* *15s.* 2$\frac{6}{7}$*d.*, which makes the *present* *worth* 95*l.* 4*s.* $9\frac{1}{7}$*d.*, and if you place this sum out at interest for 1 year at 5 per cent., the interest added to it will make exactly 100*l.*; on the other hand, if the 4*l.* 15*s.* $2\frac{6}{7}$*d.* is placed out to interest at the same rate and time, it would be 4*s.* $9\frac{1}{7}$*d.*, which added to 4*l.* 15*s.* $2\frac{6}{7}$*d.* make 5*l.*, which I shall show you by example.

The *discount* subtracted from the given sum leaves the *present worth.*

Rule. — As 100*l.*, *with* the interest for the *time given*, is to the interest, so is the sum given to the discount required.

Or, as the *amount* of 100*l.*, for the given rate and time is to 100*l.*, so is the given sum to the *present worth.*

Examples.

1. What is the discount of 100*l.* due in 12 months, at 5 per cent. per annum?

$$\begin{array}{rl} \pounds & \\ 100 & \\ \underline{5} & \\ 105 & \text{Amount of 100}l.\text{ for the given time.} \end{array}$$

$$\begin{array}{lllll} & \pounds & & \pounds & & \pounds \\ \text{As} & 105 & : & 5 & :: & 100 \end{array}$$

$$\begin{array}{r}
100 \\
\hline
105\,)\;500\;(\;\pounds 4\ 15s.\ 2\tfrac{6}{7}d. \\
420 \\
\hline
80 \\
20 \\
\hline
105\,)\;1600\;(\;15 \\
105 \\
\hline
550 \\
525 \\
\hline
250 \\
12 \\
\hline
105\,)\;300\;(\;2 \\
210 \\
\hline
\dfrac{90}{105} = \tfrac{6}{7}
\end{array}$$

£	s.	d.	
100	0	0	Amount.
4	15	$2\frac{6}{7}$	Discount.
95	4	$9\frac{1}{7}$	Present worth.

$$\begin{array}{rrr} \pounds & s. & d. \\ 4 & 15 & 2\frac{6}{7} \\ & & 5 \\ \hline 23 & 16 & 2\frac{2}{7} \\ 20 & & \\ \hline 4{,}76 & & \\ 12 & & \\ \hline 9{,}14 & & \\ 7 & & \\ \hline 1{,}00 & & \end{array} \qquad \begin{array}{rrr} \pounds & s. & d. \\ 95 & 4 & 9\frac{1}{7} \\ & & 5 \\ \hline 476 & 3 & 9\frac{5}{7} \\ 20 & & \\ \hline 15{,}23 & & \\ 12 & & \\ \hline 2{,}85 & & \\ 7 & & \\ \hline 6{,}00 & & \end{array}$$

£	s.	d.	
4	15	$2\frac{6}{7}$	Interest for 1 year on 95*l.* 4*s.* $9\frac{1}{7}$*d.*
	4	$9\frac{1}{7}$	Interest on 4*l.* 15*s.* $2\frac{6}{7}$*d.* for 1 year.
5	0	0	Interest on £100. for 1 year.

The above examples illustrate all that I have said in explanation of the Rule.

It is the custom of bankers to take *interest*, instead of *discount*, for payments not yet due, *though* they use the term discount; which yields them a considerably larger profit, as the following example will show; and to make it clear to you, the difference between the *discount* and *interest* is shown upon 500*l.*

Examples.

2. What is the discount of 500*l.* due 12 months hence, at 5 per cent. per annum?

£
500
5
25,00 Interest on whole amount.

£
100
5
105 Amount of 100*l.* for the given time.

```
          £          £          £
   As 105   :        5    ::   500
                    500
           105 )   2500 ( 23
                   210
                   ·400
                    315
                    ·85
                     20
             105 )  1700 ( 16
                    105
                    ·650
                    630
                    ·20
                     12
               105 ) 240 ( 2
                     210
                     ·30
                       4
               105 ) 120 ( ¼
                     105
                     ·15
                     ─── = ⅐
                     105
```

£	s.	d.	
25	0	0	Interest.
23	16	2¼ ⅐	Discount.
1	3	9½ 6/7	Difference.

Here you plainly see, Lavinia, a banker gets much more by taking *interest* than *discount.*

3. What is the present worth of 479*l.* 16*s.* 6*d.* due 9 months hence, at 4½ per cent. per annum?

4. What is the discount of a sum of money amounting to 500 guineas for 7 months, at 5 per cent. per annum?

5. A person bought goods for 126*l.* 15*s.*, and was to pay for them at the end of 11 months, but receiving some cash unexpectedly, he wishes to discharge the amount immediately, if he be allowed 6 per cent. per annum; what has he to pay?

LAVINIA.

I have finished the examples you gave me, and I find the trouble I took in Proportion is now very useful to me.

CONSTANTIA.

You will find, my dear, that most of the Rules we have now to converse upon, are performed by that rule.

CONVERSATION XXXIV.

ON FELLOWSHIP.

CONSTANTIA.

OUR next Rule for consideration is called Fellowship; which consists of two kinds, Single, and Double, Fellowship.

LAVINIA.

I do not see how Fellowship can be *single*. Except it be a College Fellowship, which I have heard my brother Henry say is only conferred on bachelors.

CONSTANTIA.

Perhaps it would be more correct to call it Simple Fellowship; but we must call things frequently by their customary names, though they may sometimes be incorrect.

Single Fellowship, or Partnership, is, when two or more persons join together to carry on any business; where it frequently happens that each person advances a different sum of money — but the time of partnership is equal. For example, A, B, and C, enter into partnership; A contributes 300*l.*; B, 400*l.*; and C, 500*l.*; as C advances 200*l.* more than A, and 100*l.* more than B, he is entitled to more of the *profits* than either of these two; and it is the same if any *loss* occurs, he bears the greatest share of it. You see, Lavinia, this is reasonable; for it would not be right to be entitled to the greatest share of the *gain*, and not also bear the greatest share of the *loss*.

This Rule applies also to cases where persons fail in business, and give up all they possess, for the benefit of their creditors; when each receives a part in proportion to others, according to what is owing to him.

Rule. — As the sum of all the shares is to the whole gain or loss, so is *each* man's share to his share of the gain or loss.

Proof. — Add all the shares together, and if the work be correct, the sum will be equal to the given gain or loss.

Examples.

1. Three persons entered into partnership; A, put in £120; B, £230; and C, £325, and they gained £475., what was the amount of each person's gain?

£

A, 120

B, 230

C, 325

675 sum of all the shares.

£ £ £

As 675 : 475 :: 120

120

675) 57000 (84*l.* 8*s.* 10½*d.*

5400

·3000

2700

·300

20

675) 6000 (8*s.*

5400

·600

12

675) 7200 (10*d.*

675

·450

4

675) 1800 (½*d.*

1350

·450

·675

£ £ £
As 675 : 475 :: 230
230
14250
950
675) 109250 (161*l.* 17*s.* 0¼*d.*
675
·4175
4050
·1250
675
575
20
675) 11500 (17
675
4750
4725
··25
12
300
4
675) 1200 (¼
675
525

```
     £               £               £
As 675      :       475     . ::    325
                    325
                   ────
                   2375
                   950
                  1425
         675 )  ──────
                154375 ( 228l. 14s. 0¾d.
                1350
                ────
                 ·1937
                 1350
                 ────
                  ·5875
                   5400
                   ────
                   ·475
                      20
                   ────
            675 )  9500 ( 14
                   675
                   ────
                   2750
                   2700
                   ────
                    ··50
                      12
                    ───
                    600
                       4
                   ────
            675 )  2400 ( ¾
                   2025
                   ────
                   ·375
                   ════
```

	£	s.	d.		
A's gain	84	8	10½ $\frac{450}{675}$	}	= ½
B's gain	161	17	0¼ $\frac{525}{675}$		
C's gain	228	14	0¾ $\frac{375}{675}$		
			½		
Whole gain	475	0	0		Proof.

2. A, B, and C, trading together, gained 250*l.* A put into the business 45*l.*; B, 72*l.*; and C, 95*l.*; what was each man's share of the gain?

3. Three East India merchants traded together, and during a storm at sea they had goods thrown overboard, by which they lost 850*l.*; now A's stock in trade was 2000*l.*; B's, 3000*l.*; and C's,

4050*l.*; what share of the loss did each man sustain?

4. A person fails in business owing a large amount, but gives up his stock in trade, book debts, &c., for the benefit of his creditors, amounting in all to 1435*l.* 18*s.* 9*d.*; and he owes to A, 340*l.*; to B, 496*l.* 17*s.* 3¼*d.*; to C, 643*l.* 13*s.* 7*d.*; to D, 200 guineas; and to E, 730*l.* 10*s.* What did each creditor receive for his debt?

5. A person dying, left by his will, to A 95*l.*; to B, 140*l.*; to C, 250*l.*; but it was found after his decease, that he had only 380*l.* 12*s.* 6*d.* left, when his funeral expenses and debts were paid; what was the amount of each legacy?

DOUBLE FELLOWSHIP.

CONSTANTIA.

Double Fellowship is when money is advanced for the purposes of trade, and continued for *unequal* periods of time, which may be increased or diminished at the pleasure of the parties.

Rule. — The only difference, Lavinia, between this Rule and the last, is, that you *multiply* each man's *stock and time* together, and add the several products into one sum. Then, as the sum of these products is to the whole gain or loss, so is *each* product to its share of the gain or loss.

I do not think it necessary, Lavinia, to give any example at length in this Rule, but to show you the method of gaining the product of each man's stock in trade.

Proof as in Simple Fellowship.

1. Three merchants join in trade; A puts in 400*l.* for 9 months; B, 680*l.* for 5 months; and C, 120*l.* for 12 months; and gain 500*l.*; what is each man's share?

	£				£	
	400	×	9	=	3600	A's stock and time.
	680	×	5	=	3400	B's ditto.
	120	×	12	–	1440	C's ditto.
Sum of the products					8440	

Then,

	£		£		£		£	s.	d.		
As	8440	:	500	::	3600	:	213	5	$4\frac{3}{4}$	$\frac{2840}{8440}$	= $\frac{1}{2}$
As	8440	:	500	::	3400	:	201	8	5	$\frac{7840}{8440}$	
As	8440	:	500	::	1440	:	85	6	$1\frac{3}{4}$	$\frac{6200}{8440}$	
									$\frac{1}{2}$		
							500	0	0	Proof.	

2. Three persons hire a meadow, for which they pay 36*l.* per annum; A puts in 5 oxen for 4 months; B, 9 oxen for 8 months; and C, 12 oxen for 12 months; what has each to pay towards the rent?

3. Three merchants, A, B, and C, engage in partnership; A puts in 432*l.* 16*s.* 6*d.* for 7 months; B, 324*l.* 10*s.* for 9 months; and C, 835*l.* 16*s.* 6*d.* for 5 months; in trading they gained 375*l.*; what was each person's share?

4. Two persons, A and B, traded together with a stock of 400*l.* A's money was employed 12 months, and B's 8 months; and when their profits were divided, they had equal shares; what was the amount of each man's stock?

CONVERSATION XXXV.

ON BARTER.

LAVINIA.

I HAVE found the last Rule rather simple; pray, will you tell me our subject for conversation to-day?

CONSTANTIA.

Our present subject, my dear, is called Barter, which is the exchanging of one commodity for another, and the value of these is determined by the Rule of Three, so as that neither party sustain any loss.

It is difficult to lay down a Rule that will apply to all questions; but as you are now pretty well acquainted with the Rule of Three, most of them will appear easy to you. But, generally, you have to find the value of that commodity, whose *price* and *quantity* are given, and say, as the price of an integer of the *required* quantity is to *that* integer, so is the value of the *given* quantity, which you have already found, to the required quantity.

Examples.

1. How many yards of cloth, at 12*s.* 6*d.* per yard, can I have for 1200 yards of flannel, at 1*s.* 10*d.* per yard?

```
   d.   s.     yards.
 | 6 | 1/2 |   1200
 | 4 | 1/3 |    600
                400
         2,0 ) 220,0
              £110-0   Value of Flannel.
```

```
Then,        s.  d.      yard.       £
      As     12  6   :    1    ::   110
             12                      20
             150                    2200
                                      12  Yds.
                            15,0 ) 2640,0 ( 176  Ans.
                                   15
                                   114
                                   105
                                     90
                                     90
                                     ..
```

Or, by Inverse Proportion, —

```
        s.  d.          yds.              s.  d.
As,     1  10    :      1200      ::      12  6
        12                22              12
        22              2400              150
                       2400
                15,0 ) 2640,0 ( 176 yds. — Answer,
                       15                as before.
                       114
                       105
                         90
                         90
                         ..
```

2. Two persons, A and B, barter in trade; A has 21 cwt. of sugar, at 2*l.* 18*s.* per cwt., for which B gives him 10*l.* in cash, and the rest in cheese, at 7½*d.* per lb.; what quantity of cheese must A receive?

3. How much rice, at 5*d.* per lb., must be bartered for 3 cwt. of raisins, at 6¾*d.* per lb?

4. What quantity of tea, at 4*s.* 6*d.* per lb., must be bartered for 81 lbs. 10 oz. of coffee, at 1*s.* 10½*d.* per lb.?

5. A sold to B 5 hhds. of French brandy, at 36*s.* per gallon, for 500 yards of cloth; what was the cloth per yard?

6. B and C bartered; B had 22 cwt. 1 qr. of sugar, worth 1*l.* 18*s.* 6*d.* per cwt., which he exchanged with C for wine, at 24*s.* per gallon; how much wine did B receive?

7. A and B barter; A has 32 cwt. of hops, at 5*l.* 5*s.* per. cwt., for which B gives him 20*l.* in money, and the rest in sugar, at 6½*d.* per lb.; how much sugar must B give to A, besides the money?

8. How many pieces of money, worth 3*s.* 4*d.* each, are worth 120, at 5*s.* 6*d.* each?

CONVERSATION XXXVI.

ON PROFIT AND LOSS.

CONSTANTIA.

THIS Rule, Lavinia, like the last, is chiefly performed by the Rule of Three, and by it merchants or tradesmen determine what is lost or gained in buying or selling goods; or you may by it determine the gain or loss in any transaction of business where money is concerned.

The *prime* cost is the *first* price given, and is used by traders to distinguish it from the *selling* price.

PROOF.—In order to prove your work, the best way is to reverse the order of the stating, as in the Rule of Three.

Examples.

1. Bought 3 cwt. of sugar, at 2*l.* 2*s.* per cwt., and sold it at 6½*d.* per lb.; what was the gain on the whole?

$$\begin{array}{rrl} \pounds & s. & \\ 2 & 2 & \\ & 3 & \\ \hline 6 & 6 & \text{Total value.} \end{array}$$

$$\begin{array}{lcccccr} \text{Then,} & \text{lb.} & & d. & & & \text{lbs.} \\ \text{As} & 1 & : & 6\frac{1}{2} & :: & & 336 \\ & & & 4 & & & 26 \\ \cline{4-4}\cline{7-7} & & & 26 & & & 2016 \\ & & & & & & 672 \\ \cline{7-7} & & & & & 4\,) & 8736 \\ \cline{7-7} & & & & & 12\,) & 2184 \\ \cline{7-7} & & & & & 2{,}0\,) & 18{,}2 \\ \cline{7-7} & & & & & & 9\text{—}2 \end{array}$$

$$\begin{array}{lrrrl} & \pounds & s. & d. & \\ & 9 & 2 & 0 & \text{Sold for.} \\ & 6 & 6 & 0 & \text{Prime cost.} \\ \cline{2-4} \text{Answer.} & 2 & 16 & 0 & \text{Gain.} \end{array}$$

2. If a person buys sugar at 6*d.* per lb., and sells it at 7½*d.* per lb., what is the gain per cent.?

3. If a person buys 150 yards of cloth at 5*s.* 6*d.* per yard, and sells it at 6*s.* 9*d.*, what is the whole gain?

4. Bought a quantity of goods for 80*l.* 15*s.*; and sold them again, on account of their being damaged, for 65 guineas; what was the loss per cent.?

5. A person having on hand a quantity of cloth some time, the selling price of which was 5*s.* 6*d.* a yard; but he, willing to effect the sale, reduces the price 15 per cent., what must be the price of a yard?

6. If a person buys 35 yards of cloth for 25*l.*, and sells it out at 8*s.* 4*d.* a yard, what is gained or *lost* by the bargain?

7. A person bought 325 lbs. of tea at 3*s.* 9½*d.* per lb., and wishes to gain 25 per cent. by it; what must be the selling price of a pound?

8. A merchant bought 12 cwt. 2 qrs. of sugar at 7½*d.* per lb. and gained at the rate of 25 per cent.; what was the whole gain?

9. If a merchant loses 17½ per cent. by goods which cost him 500 guineas, what will be his whole loss on the transaction?

CONVERSATION XXXVII.

ON EQUATION OF PAYMENTS.

CONSTANTIA.

The subject for this morning's consideration is called Equation of Payments; and when payments are due at different periods of time, by this Rule you may adjust them for payment at *one* time.

Rule. — Multiply each payment by its *time*, and divide the *sum* of all these products by the *sum* of the payments, and the quotient will give the time required.

Examples.

1. A owes B 100*l.*, whereof 50*l.* is to be paid at 2 months, and 50*l.* at 4 months, at what time must they be made in one payment?

$$\begin{array}{rcccl} \pounds & & \text{m.} & & \\ 50 & \times & 2 & = & 100 \\ \underline{50} & \times & 4 & = & \underline{200} \\ 1{,}00 &) & & & 3{,}00 \\ & & \text{Answer} & & \underline{3}\ \text{Months.} \end{array}$$

2. A merchant buys goods amounting to 300*l.* to be paid as follow — 50*l.* at 2 months, 100*l.* at 5 months, and the rest at 8; but he wishes to discharge it at one payment; what must the time be?

3. B owes C 1000*l.*, whereof 200*l.* is to be paid present, 400*l.* at 5 months, and the rest at 10 months; what is the equated time?

4. A owes B a certain sum of money, which is to be paid ½ present, ¼ at 4 months, and the rest at 8 months; what is the equated time for the whole?

5. A debt of 700*l.* is to be discharged, thus, 150*l.* present, 300*l.* at 6 months, 200*l.* at 9 months, and the rest at 12 months; what is the equated time for payment of the whole debt?

CONVERSATION XXXVIII.

ON POSITION.

CONSTANTIA.

THE Rule of Position is a rule by which you may discover truth by making use of *supposed* numbers, and consists of two kinds, Single and Double Position.

LAVINIA.

It seems rather curious to use *false* numbers to obtain *true* ones.

CONSTANTIA.

It is not the number that signifies, it is the *proportion* that is made use of that must correspond with that given in the question.

RULE. — Make use of some convenient number, and proceed with it according to the nature of the question, using the same *proportions*; and observe whether the result of the work be too much, or too little.

Then by the Rule of Three, say, as the result of the *false* number is to the number itself, so is the result in the question to the true number.

Examples.

1. Two men having found a bag of money, disputed about who should have it; when one said to the other, that $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ of the contents made 130*l.*, and if the other could tell how much was in it, he should have all, or nothing; how much was in the bag?

Suppose he had £420

$\frac{1}{2} = 210$

$\frac{1}{3} = 140$

$\frac{1}{4} = 105$

455

Then,

As £455 : £420 :: £130

$$\begin{array}{r} 420 \\ 130 \\ \hline 12600 \\ 420 \\ \hline \end{array}$$

$$455 \;)\; 54600 \;(\; 120l. \text{ Answer.}$$

$$\begin{array}{r} 455 \\ \hline \cdot 910 \\ 910 \\ \hline \ldots \end{array}$$

£120

$\frac{1}{2} = 60$

$\frac{1}{3} = 40$

$\frac{1}{4} = 30$

130 Proof.

2. A boy playing at marbles, being asked how many he had won, replied, that if he had as many more, and half as many more, he would have won 120; what number was that?

3. A person had in his possession a certain number of crowns, and if $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ of them were added together, they would make 65; how many had he?

4. A gentleman delivered to a banker to receive of him interest after the rate of 5 per cent. per annum, and at the end of 10 years received 500*l.* for principal and interest; what was the sum delivered to the banker?

5. Three persons, A, B, and C agree to pay a reckoning amounting to 50*s*; A is to pay $\frac{1}{2}$; B, $\frac{1}{3}$; C, $\frac{1}{4}$; what is each man's share?

6. A general, after sending out foraging $\frac{1}{2}$ and $\frac{1}{3}$ of his men, had a thousand remaining; what number had he under his command?

DOUBLE POSITION.

CONSTANTIA.

This Rule, Lavinia, is much more difficult to see the reason of than Single Position, but I shall give you a rule as easy to comprehend as possible.

In Double Position, you make use of *two* supposed numbers, and work them as if they were the *true* numbers, and in the same *proportion* as the question directs.

RULE.—Assume any *two* convenient numbers, and proceed with them according to the question, the same as in the last Rule; observing what difference there is between the result of the *assumed* numbers and the result mentioned in the *question;* and call these differences the *errors;* at the same time observe whether these results are too *great,* or too *little.*

You must then place down each error opposite to the *contrary* supposition; that is, opposite to the *first* supposition place the error of *the second* supposition; and against the *second* supposition, the *first* error; or you may write down each error against its corresponding supposition, and multiply them *cross-ways.*

If the *errors* are *alike,* that is, both *greater,* or both *less,* than the given number, take their *difference* for a *divisor,* and the *difference* of their *products* for a *dividend.*

If the *errors* are *unlike,* take their *sum* for a *divisor,* and the *sum* of their *products* for a dividend.

Examples.

1. Three persons, A, B, and C, divided amongst themselves 1000*l.,* so that B had 3*l.* more than A, and C 4*l.* more than B; what sum had each person?

	£			£	
Suppose A had	150		Suppose A had	280	
	3			3	
B had	153		B had	283	
	4			4	
C had	157		C had	287	
				850	
Sum of the Shares.	1000		Sum of the Shares	1000	
	540	Too little.		150	Too little.

Second Error.

1st.Sup. 150 × 150 = 22500

2nd Sup. 280 × 540 = 151200 £

$39{,}0\ )\ 12870{,}0\ (\ 330$ A's share.

117

117

117

...

	£
A's share	330
	3
B's share	333
	4
C's share	337
	1000 Proof.

2. A, B, and C built a house which cost 500*l.*, of which B paid 50*l.* more than A, and C as much as A and B together; what did each man pay?

3. Three persons discoursing together about their ages, when A said, I am 20 years of age; B said, I am as old as A and half C; and C said, I am as old as you both; what was each person's age?

4. What number is that, which, if multiplied by 8, the product increased by 18, and that sum divided by 9, the *quotient* will be 20?

5. A person distributed in charity 2*d.* a piece among several poor children; he would have given them 3*d.* each, but wanted 10*d.*; what was the number of children?

CONVERSATION XXXIX.

ON EXCHANGE.

CONSTANTIA.

The subject for our present consideration is called Exchange; and by it is meant the Exchanging of Money of one place for that of another, by means of written papers, called Bills of Exchange, used among merchants.

LAVINIA.

Then it is something like bartering, I suppose?

CONSTANTIA.

It is, in reality, a kind of barter; and so numerous are the transactions of our merchants with foreign countries, that the affairs of our *Stock Exchange,* or money market, are considered of the greatest importance; and it is there that money is bought and sold by sums of hundreds of thousands. As this rule would occupy too much of our time to enter into all its particulars, without being necessary to know, I shall only give you an Example, that you may not be quite ignorant of its use.

To reduce Foreign money into English, and the contrary.

To suit our present purpose, let us reduce Dutch money into English, and English money into Dutch. In Holland, exchanges are computed in guilders, stivers, and pennings; or pounds, shillings, and pence, Flemish. The following is a table of Exchange: —

8 Pennings............... = 1 Grote, or penny.
2 Grotes.................. = 1 Stiver.
6 Stivers.................. = 1 Shilling, Flemish.
3⅓ Shillings, Flemish ... = 1 Florin, or Guilder.
2½ Florins................. = 1 Rix-dollar.
2⅖ Rix-dollars............ = 1 Pound Flemish.

Rule. — To reduce Dutch money into English, say, — As the given rate of Exchange is to £1. sterling, so is the given Dutch to the sterling sought: to reduce sterling into Dutch, reverse the rule. This will apply to all exchanges, by substituting the money of other countries with the rate of exchange.

Examples.

Reduce 8132 guilders, or florins, 16 stivers, into sterling; exchange at 10 florins, 8 stivers, per pound sterling.

First.

```
      gs. st.        £         gil.  stiv.
As    10  8    :     1   ::    8132  16
      20                         20     £
      ---                     ------
      208              208 ) 162656 ( 782 Answer.
                             1456
                             ----
                             ·1705
                              1664
                              ----
                              ··416
                                416
                                ---
                                ···
```

To reduce English into Dutch.

```
      £        gs.  s.          £
As    1    :   10   8    .:    782
                20
               ---
               208
               782
               ---
               416
             1664
            1456
           -------
   2,0 )   16265,6
           -------
           8132 16
```

Answer, 8132 guil. 16 stivers.

LAVINIA.

It appears, then, that Exchange is chiefly performed by Proportion.

CONSTANTIA.

It is so; and from the knowledge you now have of arithmetic, all examples of the kind will be easy to you.

CONVERSATION XL.

ON ARITHMETICAL PROGRESSION.

CONSTANTIA.

THIS is the last Rule, Lavinia, that I shall make a subject for our conversation, trusting that your industrious application to what we have hitherto conversed about, will render you competent to perform all that is required in your station.

LAVINIA.

But I suppose it is not all that could be learned in figures?

CONSTANTIA.

Indeed not; many of the learned men at our Universities, Oxford and Cambridge, have spent the greater part of their lives in acquiring the superior mathematical knowledge they possess.

Progression is of *two* kinds, *Arithmetical* and *Geometrical;* the former is the one we must talk over first.

Arithmetical Progression is when a series of numbers increase or decrease by equal *differences*, as,—

2, 4, 6, 8, 10, 12; or, 16, 14, 12, 10, 8, 6, &c.;

the *first* and *last* terms of which are called the *extremes;* and the other terms between them, the *means.*

In any continued Arithmetical Progression, the *sum* of the two *extremes* is equal to the *sum* of any two *means equally* distant from them, or equal to *double* the *middle* term, when the number of terms is uneven; thus,—

2, 4, 6, 8, 10, 12, 14, 16, 18, 20.

Here the two extremes 2 + 20 = 22, and 14 + 8 = 22, because they are equi-distant from the extremes. Now take an *uneven* number of terms—

3, 5, 7, 9, 11, 13, 15.

Here 3 + 15 = 18; and *double* the *middle* term 9, makes 18.

The difference between the two *extremes* of an Arithmetical Progression is equal to the common difference of the *series*, multiplied by *one less* than the numbers, thus:—

4, 6, 8, 10, 12, 14,

is an Arithmetical Progression, whose *common difference* is 2; which multiplied by the number of terms, *less* 1, is 5 × 2 = 10; and the difference between the two extremes is 14 − 4 = 10; therefore the *greatest* term is equal to the *least* term, added to the product obtained by multiplying the common difference into the number of terms, less 1.

The *sum* of *all* the terms of any Arithmetical Progression is equal to the sum of the two extremes, multiplied by the number of terms, and divided by 2; or the sum of the two extremes, multiplied by the number of terms, gives *double* the sum of all the terms in the series; which I can explain to you, by setting the terms of the series in an *inverted* order, under the same series in a *direct* order, and adding the corresponding terms together in that order.

Thus,

Direct series ...	1,	3,	5,	7,	9,	11,	13,	15.
Inverted series..	15,	13,	11,	9,	7,	5,	3,	1.
	16,	16,	16,	16,	16,	16,	16,	16.

Here it is evident that 8 (the number of terms), multiplied by 16 (the sum of the two extremes), is equal to 128; which is *double* the sum of the terms in the *single* series, and is equal to the sum of the extremes repeated as often as the number of the terms.

From the above you may easily find out the following:—

The two extremes;
The number of terms;
The common difference; and

The sum of all the terms; where any three of them are given.

LAVINIA.

It appears to me to explain the nature of the Rule of Three.

CONSTANTIA.

It may give you some idea of it, but that belongs more particularly to Geometrical Progression.

Case I. — Given the extremes of the number of terms, to find the sum of all the terms.

Rule. — Add the extremes together, multiply by the number of terms, and divide by 2.

Examples.

1. The extremes being 2 and 16, and the number of terms 8, what is the sum of the terms?

	16	
	2	
	18	Sum of extremes.
	8	Number of terms.
2)	144	
Sum	72	Answer.

2. How many strokes will a clock strike in 24 hours, or two revolutions on the dial plate?

3. A person sold 26 yards of linen, the first

yard for 1*s.*, the second for 2*s.*, &c.; how much did he receive for his cloth?

4. Bought 15 yards of cloth, and gave 2*s.* for the first yard, 4*s.* for the second, and so on in the same proportion; what did the cloth cost?

5. If a man place 100 stones in a straight line, exactly a yard from each other, how far must he walk to gather them up, if he takes up every stone singly, and carries it to a basket 1 yard distant from the first?

Case II.—When the extremes and the number of terms are given, to find the common difference.

Rule.—Subtract the *less* extreme from the *greater*, and divide the remainder by the number of terms, less 1.

Examples.

1. If the extremes be 10 and 70, and the number of terms 21, what is the common difference?

70 Greater extreme.
10 Less extreme.
2,0) 6,0
Common dif. 3 Answer.

2. A debt can be discharged in 1 year by weekly payments in Arithmetical Progression, the first payment being 1*s.*, and the last 5*l.* 3*s.*; what is the common difference?

3. A debt is to be discharged at 16 several payments in Arithmetical Proportion, the first

payment to be 14*l*., and the last 100*l*.; what is the whole debt, and what the common difference?

CASE III. — When one of the extremes, the common difference, and the number of terms are given, to find the other extreme and the sum of the series.

Rule. — Multiply the common difference by 1 *less* than the number of terms, and the product will be the difference of the extremes; therefore *add* this product to the *less* extreme to give the *greater*; but *subtract* it from the *greater* to give the *less* extreme.

Examples.

1. If the greatest term be 70, the common difference 3, and the number of terms 21, what is the least term, and the sum of the series?

First,
3 Common difference.
20 One less than the No. of terms.

60 Difference of the extremes.
70 Greater extreme.

10 Less extreme, or least term.

Then,
$\left.\begin{matrix}70\\10\end{matrix}\right\}$ Two extremes.

80
21 No. of terms.

80
160

2) 1680

840 Sum of the series.

2. Given the least term 5, and the common difference 2, in a series of 10 terms; what is the greatest and the sum of the series?

3. A debt can be discharged in 12 payments: the first payment is *5l.*, and the second *8l.*, and so on in Arithmetical Progression; what was the last payment, and the amount of the debt?

CASE IV. — To find any number of Arithmetical means between two given terms or extremes.

Rule. — Subtract the *less* extreme from the *greater*, and divide the difference by 1 *more* than the number of *means* required, which will give the common difference; and this being *added* continually to the *least* term, or *subtracted* from the *greatest*, will give the mean terms required.

Examples.

1. Find 8 Arithmetical means between 2 and 20,

20 Greater extreme.
2 Less extreme.
9) 18
2 Com. difference.

Then, 4, 6, 8, 10, 12, 14, 16, 18 are the means required.

CASE V. — To find an Arithmetical mean Proportional between two given terms.

Rule. — Add together the two extremes, and take *half* their sum for the Arithmetical mean required.

Example.

1. Find the Arithmetical mean between the two numbers 2 and 16.

$$\left.\begin{array}{r}16\\2\end{array}\right\}\text{ Extremes.}$$

$$2\,)\,\underline{18}$$

$$\underline{9}\quad\text{Mean required.}$$

2. What is the Arithmetical mean between the two numbers 4 and 18?

CONSTANTIA.

I think, Lavinia, we may now safely leave this rule.

LAVINIA.

I have been very much interested by it, for I really never imagined that so many curious questions could be done by it, when you first explained it to me; though I now remember my brothers one day talking about a man gathering up 100 stones on Kennington Common.

GEOMETRICAL PROGRESSION.

CONSTANTIA.

Geometrical Progression is somewhat different from Arithmetical, for it *increases* by a *common multiplier*, or *decreases* by a *common divisor.*

Thus,

2, 4, 8, 16, 8, 4, 2.

The *common multiplier* of the above series is 2, and the common *divisor* 2, for the *decreasing* series; for if you *multiply* the first term by 2 it makes 4, and so on; if you *divide* 16 in the *decreasing* series, it gives 8 for the next term, &c.

The first and last terms are called the *extremes* as before, and the common multiplier or divisor, the *ratio.*

There are many remarkable properties in this rule, as in the last.

In the following Geometrical series,

2, 4, 8, 16, 32, 64, 128,

the *product* of the two *extremes* is equal to the *product* of any two *means* equally distant from the *extremes,*—for $128 \times 2 = 256$, and $64 \times 4 = 256$, that is the case with every Geometrical series.

When the number of terms in the series is *uneven,* as 5, 7, 11, &c., the middle term multiplied into itself or squared, is equal to the product of the two extremes; as above, 16 × 16 = 256.

If four quantities be in Geometrical Proportion, the product of the two *extremes* will be equal to the product of the two *means;* therefore, if the product of the two *means* be divided by *one* of the extremes, the quotient will give the *other* extreme. Thus in the proportionals —

4, 8, 12, 24.

First 24 × 4 = 96, and 12 × 8 = 96.

Then, 96 ÷ 4 = 24 = the fourth term.

And 96 ÷ 24 = 4 = the first term.

This is the foundation of the Rule of Three; and to explain my meaning, I will arrange the 4 terms above, similar to a stating in that Rule, and make a question of it.

If 4 yards cost 8*s.*, what will 12 yards cost?

Then,

$$\begin{array}{lccccccc}
 & \text{yds.} & & s. & & \text{yds.} & & s. \\
\text{As} & 4 & : & 8 & :: & 12 & : & 24 \\
 & & & 12 & & & & \\
 & & & \overline{} & & & & \\
 & & 4\,) & 96 & & & & \\
 & & & \overline{24} & & & & \\
\end{array}$$

Now, if you multiply your *first* term by the *answer*, or fourth term, it is equal to the product of the second and third terms; therefore, every sum in Direct Proportion may be proved by multiplying together the *fourth* and *first* terms, which will equal the product of the *second* and *third.*

If the proportion be *inverse,* the product of the *first* and *second* terms is equal to the product of the *third* and *fourth.*

In this Rule, when you would find the *last* term in a long series of numbers, it could be done by continued Multiplication; but this method is so tedious that a more easy plan may be adopted, by setting down a series of numbers in Arithmetical Progression, beginning at No. 1, having their common difference 1, and calling them *indices.*

Then whatever number of terms you require by the question, place them in Geometrical order under the indices in the same ratio that is pointed out in the question. Thus, —

1,	2,	3,	4,	5,	6,	7,	8,	9.	Indices.
2,	4,	8,	16,	32,	64,	128,	256,	512.	Geom. series.

Now, if any two of the indices be *added* together, that *sum* will point out the index over the number that is the product of the numbers, whose indices you have added; for instance, suppose I require to find the 8th power of a series, whose *first* term and *ratio* are 2; by the above plan, indices $5+3=8$; and the number in the *Geometrical series,* corresponding to 8, is 256; which is equal to the product of 32 × 64; by this plan, when the number of terms is very great, you may save much labour by understanding these properties of figures.

But, if the *first* term in a Geometrical series be different from the *ratio*, the indices must begin with a *cipher*. Thus: —

0,	1,	2,	3,	4,	5,	6.	Indices.
1,	3,	9,	27,	81,	243,	729.	Geom. series.

But, remember, when the indices begin with a cipher, the *sum* of them must always be *one less* than the number of terms given in the question, because 1 in the indices stands over the *second* term, &c.

Examples.

1. A man bought a horse, and by agreement was to pay a farthing for the first nail, two for the second, four for the third, &c.; there were four shoes, and 8 nails in each shoe; what did the horse cost?

2. A draper sold 50 yards of cloth, the first yard for 2*s.*, the second for 4*s.* &c., in geometrical proportion; what was the quantity sold for?

3. A goldsmith sold 4 lbs. of gold, at 3*s.* for the first ounce, 6*s.* for the second, 9*s.* for the third, &c.; what did he sell it for, and what was the whole gain, if it cost him 3*l.* per ounce?

4. A servant agreed to serve his master for 12 years, and to have the produce of a grain of wheat for the first year, and that product to be sowed again for the second year, and so on till the end of

his time; what was the produce worth, supposing it to increase tenfold, and to be sold at 8*s.* per bushel, allowing 7680 grains to make a pint?

CONSTANTIA.

There are many varieties in this Rule; but I have said enough for you to be able to comprehend its nature; and you may consider our conversations on this subject as terminated.

LAVINIA.

Well, I feel that I am greatly indebted to you for your kindness, and I can only repay you by gratitude and esteem; and when papa returns from the Continent, I hope you will pay us a visit, and tell him and mamma what you think of my progress. Adieu!

APPENDIX.

THINGS USEFUL TO BE KNOWN IN READY RECKONING.

In calculating various things, *pence*, in *one* article become *shillings* in the *dozen*, and *vice versâ*. Thus:

4*d.* each is 4*s.* per dozen.
6*s.* 9*d.* a dozen is 6¾*d.* each, &c.

Shillings in the price of an article become *pounds* in the *score*, and the contrary. Thus:

8*s.* each is £8. the score.
£9. the score is 9*s.* each, &c.

If you double the *farthings* in the price of a lb. call them *shillings*, add as many *groats* as there are *farthings* in the said price, the result will give you the value of a cwt.

Example.

Soda at 2½*d.* per lb.=10×2=20*s.*; then add 10 groats, or 3*s.* 4*d.*, and you will have:

20*s.* + 3*s.* 4*d.* = £1. 3*s.* 4*d.* per cwt.

In calculating metals by the *ton*, ¼*d.* per lb. is £2. 6*s.* 8*d.* per ton; therefore, for every additional *farthing,* add £2. 6*s.* 8*d.*

In calculating things by the *long hundred*, or 120lbs., consider every *penny* 10*s*., &c. Thus :

5d. per lb. is *50s*. per cwt. or *£50*. per ton.
4½*d*. per lb. is 45*s*. per cwt. or *£45*. per ton, &c.

In calculating liquids, the *pence* in the price of a quart become *guineas* in the value of a *hogshead;* thus, wine at 3*s*. 8*d*. per quart is 44 guineas per hogshead, or 88 guineas per pipe.

At 30*s*. per gallon, or 7*s*. 6*d*. per quart, is 90 guineas per hogshead, or 180 guineas per pipe.

Questions Exercising the foregoing Rules.

Candles at 6*s*. 6*d*. per dozen, what is it per lb. ?

Buttons at 3*s*. per gross, what is that per dozen ?

Candles at 7¾*d*. per lb., what is that per dozen ?

Articles at 4*s*. each, what is that per score ?

At £7. 10*s*. per score, what is that each ?

At 5*s*. 9*d*. each, what is that per score ?

Rice at 3½*d*. per lb., what is that per cwt. ?

Iron at 1¾*d*. per lb., what is that per cwt. ?

Copper at 1¼*d*. per lb., what per ton ?

Brass at £2. 6*s*. 8*d*. per cwt., what per lb. ?

At 3*d*. per lb., what is the value of the long hundred, or 120 pounds ?

At 4½*d*. per lb., what is the value of the long hundred ?

Brandy at 30*s*. per gallon, what price per hhd. ?

Wine at 4*s*. 6*d*. per quart, what price per pipe ?

Rum at 50 guineas per hogshead, what is the price per gallon ?

Sherry at 3*s*. 8*d*. per quart, what price per pipe and hhd. ?

RECAPITULATORY QUESTIONS.

1. What does Arithmetic take its name from?

2. Is it certain by whom it was invented?

3. Who does Josephus, the Jewish historian, say invented it?

4. What country invented the figures now used?

5. What is meant by Notation and Numeration?

6. What was the population of Great Britain in 1841?

7. What was the cost of building Saint Paul's Cathedral?

8. What three celebrated characters were born in 1769?

9. The Prince of Wales was born on Lord Mayor's Day, but in what year?

10. What is the use of Simple Addition?

11. How many acres of meadow land are there in England?

12. How many years to the present time, since Rome was founded?

13. In what year did Sir Isaac Newton die?

14. What is the use of Simple Subtraction?

15. In what year was the battle of Waterloo fought? and who were conquerors?

16. What is the height of the highest mountain in Himalaya?

17. What is the height of the Duke of York's monument?

18. What is meant by the words *per annum?*

19. What is Multiplication used for?

20. Who invented the multiplication table?

21. What number of bricks are made in a minute *by the Marquis of* Tweeddale's patent machine?

22. Who destroyed the Temple of Diana at Ephesus?

23. What number of pins are consumed in a day?

24. What is the meaning of the word pendulum?

25. What is the meaning of oscillation?

26. What do you understand by Division?

27. What rule is Division intended to shorten?

28. How long does it take to convey intelligence by the telegraph from Portsmouth to London?

29. Where did Sir Thomas Lombe obtain the draft of his great silk mill at Derby?

30. What is meant by the word *unit?*

31. What is the difference between a *square* and *cube* number?

32. What do you understand by an *aliquot* part?

33. What is meant by the word *integer?*

34. What is the meaning of *£. s. d. q.* over money?

35. What is the smallest coin of our realm?

36. How much is a *groat?*

37. How much a *moidore?*

38. What a *jacobus*, a *carolus*, a *mark*, and a *noble?*

39. How many parts of copper are mixed with gold for standard coins?

40. How many *guineas* are made from a pound of standard gold?

41. How many *shillings* from a pound of silver?

42. How many *pence* from a pound of copper?

43. What is the Mint price of an ounce of gold? or silver?

44. What is the mixing of base metals with fine called? and what is it done for?

45. Why is gold considered the purest of metals?

46. What is meant by the terms *malleable* and *ductile?*

47. What is Troy weight used for ?

48. How many pounds are in a cwt. of gold ?

49. How much is a *carat?*

50. How many pearl grains in one ounce ?

51. What was the original standard of weights and measures in England ?

52. What class of tradesmen use Avoirdupois weight ?

53. What does the great pound of silk weigh ?

54. How much is a fother of lead ?

55. What is the weight of a firkin of butter ?

56. What does a truss of *old* hay weigh ?

57. How many pounds in a stone of horseman's weight ?

58. How much does a peck of flour weigh ?

59. How many bushels in a sack of flour ?

60. What is the difference between *gross* weight and *net* weight ?

61. Do chemists sell their goods by the same weight which they use in compounding their medicines ?

62. When was the English yard introduced ? and what the standard of its length ?

63. Who invented Gunter's chain ?

64. How much is a span ?

65. What is the fathom used for ?

66. What is Long measure used for ?

67. What is the use of Square measure ?

68. What class of tradesmen make use of Square measure ?

69. What is Cubic measure used for ?

70. What measure is used for gas ?

71. What is the difference between *perry* and *cider*?

72. What is *mead* made from?

73. How many bushels make a sack of potatoes?

74. What is the weight of a sack of potatoes in London?

75. Of what form should the standard bushel be made?

76. What is the *strike* used for?

77. How much is a Covent Garden half sieve?

78. How many sieves make a bushel?

79. How many sacks make a ton of coals?

80. How much should a sack of coals weigh?

81. How many in a brace?

82. What is the difference between a *common* and a *long* hundred?

83. How many sheets in a quire of paper?

84. How many quires in a ream?

85. How many *lunar* months in a year?

86. What is the meaning of zodiac?

87. What is the difference between the *diurnal* and *annual* motions of the earth?

88. What is meant by a *calendar* month?

89. What is meant by a *lunar* month?

90. What is meant by the term *solar*?

91. What causes the seasons of the year?

92. How do you discover *leap*-year?

93. How many signs are there in the zodiac? and what are they?

94. When does the *astronomical* day begin?

95. What do you mean by *cardinal* points of the compass?

96. Does the sun always rise in the east?

97. When is the sun at mid-day?

98. When does the sun rise in the east, and set in the west?

99. What writer in the Bible mentions the heavenly bodies?

100. From what nation is our calendar derived?

101. How was the year at first divided?

102. What king made the year to consist of twelve months?

103. Whom did Julius Cæsar employ to regulate the calendar? and how long did it continue?

104. In what year did the "new style" begin in England?

105. Give an account of the derivation of each month in the year?

106. Give the derivation of the days in the week.

107. How did the Hebrews divide the night?

108. How the Jews?

109. How was the talent divided among the Egyptians?

110. How much was the Egyptian cubit in English measure?

111. What was the value of a Jewish *silver*, and *gold* shekel in our money?

112. What was a Jewish cubit? a span? and a palm?

113. What was a day's journey among the Jews? and Sabbath-day's journey?

114. How many principal weights had the Greeks? and what were they called?

115. What did the talent weigh mentioned in the writings of Homer? and what was it called?

116. What was the length of the Macedonian foot?

117. What was the smallest weight amongst the *Romans?*

118. Into how many parts was the *libra*, or pound divided?

119. What was the Roman *denarius* worth?

120. What was the value of a Roman *as?*

121. How did the Romans reckon their money?

122. How many *sestertii* made a *sestertium?* and what was the value of each?

123. How many feet in a Roman mile? and how many yards?

124. Where is money first mentioned in the Bible?

125. What methods did the ancients use in their bargains before money was adopted as a medium of exchange?

126. What king made silver "to be as stones in Jerusalem?"

127. Where is it mentioned that "linen yarn" was sold to the "king's merchants at a price?"

128. Where were gold and silver first coined?

129. With what image did the Romans stamp their coins?

130. Of what metals were the oldest Hebrew coins?

131. What does Julius Cæsar say of British money?

132. In the reign of what Roman emperor did Cunobelinus live?

133. What place is supposed to have been the ancient Camulodunum?

134. In whose reign did the Romans forbid the use of money, not bearing the *Imperial* stamp?

135. What coins were most in use amongst the ancient Saxons?

136. How did the Saxons reckon their money?

137. What mode of calculation is used in *Domesday Book?*

138. What value was formerly put upon a man or slave?

139. What was the term *sterling* derived from?

140. In whose reign was the *groat* issued?

141. What coins first bore upon them the motto, *Dieu et mon droit?*

142. Where was the *mark* first mentioned?

143. Where was Guthrum, the Danish chief, supposed to be buried?

144. In whose reign was the *angel* coined? and why was it called so?

145. What king first coined *shillings?*

146. What king first coined *crowns, half-crowns,* and *sixpences* for circulation?

147. Who first issued *copper* money?

148. What kind of money did Oliver Cromwell coin?

149. What is meant by *obsidional* money?

150. In what year were *guineas* first coined? and whence did they receive that name?

151. In whose reign was the figure of Britannia first placed on the copper coinage? and in honour of whom was it done?

152. In whose reign did the custom of changing the position of the head of the sovereign upon coins first take place?

153. What king first adopted the motto, *Fidei Defensor?*

154. In whose reign were *quarter-guineas* first issued?

155. What is meant by *Maunday* money? and what is the term derived from?

156. What is meant by "*trial of the pix?*"

157. How is gold and silver of the *money* standard marked?

158. How is the letter of the Goldsmith's Company used to denote the year of its being impressed upon silver and gold?

159. What are the assay marks of London, Edinburgh, Dublin, Newcastle, Sheffield, and Birmingham?

160. What is the use of compound Addition?

161. What is the use of compound Subtraction?

162. What will be the age of the Prince of Wales, should he live to his birth-day in 1851?

163. What is the use of compound Multiplication?

164. At what rate per day does the population of England increase?

165. What is the average number of letters posted per minute?

166. What is meant by compound Division?

167. Explain the meaning of the word Reduction.

168. What is meant by Reduction *as*cending and *de*scending?

169. What is meant by Proportion? and how many kinds are there?

170. Explain the nature of each.

171. What does Practice receive its name from?

172. What is a Fraction?

173. Explain it by example.

174. How many kinds are there?

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